# Internet of Everything and the Public Sector

Generating Value in an Era of Change

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# Internet of Everything and the Public Sector

Jurisdiction Profiles — **Americas**

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# IoE-Fueled Capabilities Enable City of Chicago to Improve Operations and Public Transit Service



## EXECUTIVE SUMMARY

### Objectives

- Department of Innovation and Technology: Leverage technology to improve Chicago's constituent services, efficiency, and government transparency
- Chicago Transit Authority: Provide real-time data on bus/train locations and arrival times

### Strategy

- Employ five broad strategies to realize vision of using technology to fuel opportunity, inclusion, engagement, and innovation

### Solutions

- Chicago SmartData Platform will utilize open-source, predictive analytics to aid in developing models for service improvement
- WindyGrid spatial analytics platform empowers data visualization and service delivery
- Open-data portal (data.cityofchicago.org) contains datasets on wide range of city services, maps, and statistics
- CTA's Bus Tracker System provides bus location information for automated stop announcements and bus location tracking services. Train Tracker provides similar capabilities

### Impact

- Ability to analyze various datasets provides insights for improving operations
- Solutions improve transit management and customer service
- Open-source applications increase knowledge and usage of city services, while providing solutions that can be used by other cities around the world

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

 

## About the Department of Innovation and Technology

The Chicago Department of Innovation and Technology (DoIT) oversees technology application and implementation throughout the City of Chicago government. In 2013, DoIT released the City of Chicago Technology Plan, which provides overarching strategy and an organizational framework for how the city utilizes technology to enhance the well-being of city residents.

The plan, which combines both existing and new programs, highlights 28 initiatives within five broad strategies that together will enable Chicago to realize its vision of becoming a city where technology fuels opportunity, inclusion, engagement, and innovation. Two of the strategies are foundational, providing opportunities for Chicago residents and businesses to become increasingly digitally connected and engaged. Three additional strategies are growth strategies, building on the connected foundation to provide improved services, economic growth, and opportunity throughout the city. Together, these five technology-focused strategies provide the path to solidifying Chicago's place as one of the world's leading cities.

The plan, which combines both existing and new programs, highlights 28 initatives within five broad strategies that together will enable Chicago to realize its vision of becoming a city where technology fuels opportunity, inclusion, engagment, and innovation.

The Plan's five strategies are:

- **Next-Generation Infrastructure (foundational):** Enable residents and businesses to become more digitally-engaged
- **Every Community a Smart Community (foundational):** Ensure full participation of all Chicago residents and businesses in the digital economy through training and engagement programs that make technology relevant, useful, and productive
- **Efficient, Effective, and Open Government (growth):** Leverage data and new technology to make government more efficient, effective, and open
- **Civic Innovation (growth):** Work with civic technology innovators to develop creative solutions to city challenges
- **Technology Sector Growth (growth):** Encourage the vibrancy of Chicago's technology sector by attracting and retaining STEM (science, technology, engineering, and math) professionals and supporting the creation and expansion of technology companies

Brenna Berman is commissioner and chief information officer for the City of Chicago Department of Innovation and Technology. Ms. Berman previously worked as DoIT's 1st deputy commissioner and as deputy budget director for the City of Chicago, with a focus on enterprise initiatives and enterprise IT consolidation. She also has prior experience with IBM, where she promoted innovation in public initiatives.

## About the Chicago Transit Authority

The Chicago Transit Authority (CTA) provides a powerful example of the type of technological innovation that entities in the Chicago area are utilizing to enhance service delivery. The CTA has invested in technology to track public transportation throughout the city and provide real-time information to bus and train commuters. The system combines onboard computers, GPS systems, smartphone applications, SMS, and web-accessible updates that assist in navigating throughout the city.

 

John Flynn is chief information officer for the Chicago Transit Authority. He previously served as vice president of technology management with the same organization, and as deputy budget director for the City of Chicago. He also has work experience as a program manager for Cubic Transportation Systems, and as CIO for the Attorneys' Liability Assurance Society.

## Objectives

### Department of Innovation of Technology

The Department of Innovation and Technology, through the Tech Plan, has adopted a focused strategy of utilizing data and analytics to improve city services. Chicago's SmartData Platform utilizes open-source, predictive analytics to empower city leaders to make more intelligent decisions. The platform aggregates and analyzes city data to discover trends and provide insights.

DoIT Commissioner and City CIO Brenna Berman said, "We're very focused in Chicago about becoming as data-driven as we can be in the provision of services to our residents. As CIO, part of my responsibility is to be executive over our advanced analytics and data management program and making sure that we're using data and technology to make our services work. We are the platform to enable innovation."

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Brenna Berman,
Commissioner & Chief Information Officer,
City of Chicago Department of Innovation and Technology

### Chicago Transit Authority

CTA embarked on its user-friendly modernizations initially due to a need to provide clear stop and route information to all its passengers, particularly those with disabilities. The system has grown to enable a powerful, real-time transit tracking system that informs both passengers and CTA officials about transit operations.

## Strategy

### Department of Innovation and Technology

Chicago city officials believe that connecting people and data is key to improving the well-being of city residents. The department collects, compares, analyzes, and distributes data to facilitate and foster those connections.

Chicago's award-winning SmartData Platform, currently in development, will apply predictive analytics to more than 7 million rows of city-related data per day to determine trends and patterns. The city's datasets are extensive, including building and infrastructure data, roadway use and transit information, public safety information, economic development data, school achievement data, as well as city administration and budget information. The SmartData Platform will analyze this data as a means to find ways to improve service delivery.

A key component of the SmartData Platform is the city's "WindyGrid" tool, which makes key operational data accessible to city officials by providing a unified geospatial dashboard. WindyGrid allows emergency responders and other city officials to visually see what is happening throughout the city to expedite response. The platform also aggregates significant data from outside sources, such as NOAA weather information and even social media feeds such as Twitter. Much of this data is updated in real time.

 

In addition to analyzing data via the SmartData Platform, the City of Chicago also makes much of its raw data available publicly via an online data portal. According to Ms. Berman, this data-sharing initiative improves transparency and accountability within city operations, and provides highly relevant and useful information to the public.

While the portal, developed in 2011, predates the overall Technology Plan, it now forms a key component of the plan. The data portal's content includes city service schedules, public utilities and maintenance data, maps, and police information, all provided free of charge. There are currently more than 500 publicly available datasets, and, at the mayor's direction, the city does not charge for any of the data it releases to the public.

A number of smart transport initiatives undertaken by CTA, including Bus Tracker and Train Tracker, provide real-time data on bus and train locations and arrival times, both for the benefit of traffic management and for end-user notifications.

The City of Chicago technological initiatives are publicly funded through a variety of taxes (federal, state, and local), fees, bonds, and grants.

### Chicago Transit Authority

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The Chicago Transit Authority is a public institution created in 1947 by an act of the Illinois State Legislature. The CTA was formed as a separate entity from existing city agencies, and is controlled by a seven-member board of directors. Four board members are appointed by the mayor, with three appointed by state government representatives.

Mr. Flynn indicated that half of the CTA's $1.3 billion operating budget is derived from public fares, and the remaining 50 percent is received through a sales tax subsidy. Budgets for capital improvements, including the technological initiatives described herein, are funded through grants and bonds, including significant contributions from the Federal Transit Administration. Bond revenue is provided at the state or city level, or from bonds issued directly by the CTA.

## Solution

### Department of Innovation and Technology

By bringing city data together for analysis, DoIT is empowering new and innovative solutions to city problems. According to Ms. Berman, correlations in the various data gathered can yield new insights. The city's SmartData Platform forms the backbone of the data analysis efforts. By aggregating data from many sources throughout the city, the platform provides a coordinated view of city operations that breaks information silos and improves perspective, understanding, and coordination of decision makers.

One unique example of a solution developed via the SmartData Platform is a data model that predicts the likelihood of future rat infestations in specific areas. The model combines data from 31 different call types reported to the city's 311 center, ranging from sick pets to abandoned buildings. "We started looking at our 311

 

dataset as an incredibly wealthy source of data," said Ms. Berman. "We have a single system and a single database that tracks all of our 311 calls. So far, there doesn't seem to be an end to the relationships that we can test against that."

DoIT, in conjunction with other Chicago government entities, is using similar predictive models in other facets of city operations. Using WindyGrid, the city's spatial analytics platform, city officials are able to integrate various GIS data sources such as weather, public transit, and roadway information. Real-time data feeds – such as location information sent by GPS units placed on all city government vehicles, including snowplows and buses – allow analysis of travel times, weather-related road disruptions, and other incidents. The data also provides insight into how well various city agencies are performing on things like clearing city streets after a storm.

According to Ms. Berman, the goal of providing city data openly is to increase transparency and empower city residents to "hold accountable" their public officials.

DoIT has been at the forefront of another key initiative, making city data publicly accessible. The city's open-data portal (data.cityofchicago.org) contains many of the city's datasets covering a range of city services. The portal also includes maps and statistical information that allows the public to see how efficiently the city is providing service.

According to Ms. Berman, the goal of providing city data openly is to increase transparency and empower city residents to "hold accountable" their public officials. Additionally, the open-data initiative has generated an active civic app development community that helps make the data easier to read and understand via specifically designed apps that pull from the city data.

Some of the apps that have been developed based on Chicago city data include a snowplow tracker app that allows users to see which streets have been cleared following a storm; an app that helps locate available parking spots; a "where's my car" app that provides data on towed vehicles; and an app that provides status updates on responses to city 311 service calls.

## Chicago Transit Authority

Chicago Transit Authority's Bus Tracker System is one specific IoE example that has proven extremely useful in Chicago. Bus Tracker provides bus location information for automated stop announcements as well as bus location tracking services.

Bus Tracker was originally designed as a computerized stop announcement system that called out each upcoming stop automatically as the bus approached it. The purpose of the service was to ensure that all passengers were informed about the stops – specifically, those passengers who had difficulty reading route maps and signs – since drivers were not consistent in how they called out stops. According to Mr. Flynn, this enabled bus drivers to focus on driving without worrying about announcing each stop as the bus approached. However, the success of the Tracker today is due to wide usability beyond its original intent.

The key is in Bus Tracker's technology, which can be applied for many purposes. Each of the city's 2,000 buses has an onboard computer and GPS, which connect via modem to a central data server at 15- to 30-second intervals. The central

 

receiving system, Bus Time, processes incoming data for traffic management, while logarithms also produce arrival predictions for consumers. Information is published from the Bus Time system to an API for access by smartphone applications and other commuter notification systems. The system compensates for time-of-day traffic flow.

CTA also sends on-demand text messages with real-time information for those without smartphones, using the same database. "If you're standing at the bus stop, you can send a text message with the number of the bus stop, and it returns the next three buses that are coming," Mr. Flynn explained. "We get over 2 million hits a month on just that text-messaging function alone. Since they're all using the same data source, they all have the same degree of accuracy. The difference is just in the look and feel with the buttons and functionality that these apps may provide." Arrival information is also available on the CTA's website, www.bustracker.com, and on Bus Tracker signs at 250 of the busiest stops throughout the city.

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Chief Information Officer,
Chicago Transit Authority

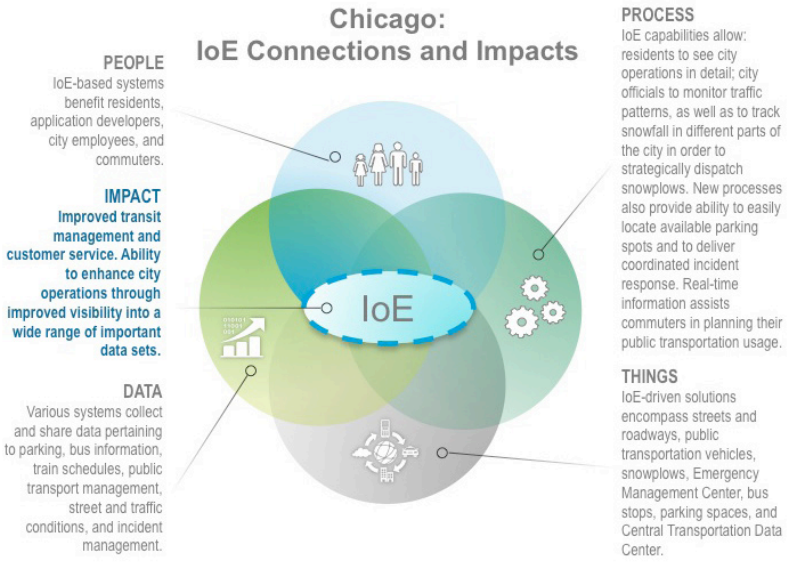
Once the system was developed, Mr. Flynn says that bus scheduling and real-time location information was made available for private application development. "When the smartphones came along ... and people started developing apps, we realized that we just didn't have the internal capability to keep up with this. We decided to just publish the data and let the public develop apps and let the best one win. Now there's probably half a dozen apps that you can buy on the iPhone and Android stores that are CTA Bus Tracker apps. They all use the same data feed, which is published through an API, and anybody can plug into it. We also felt that this would be the quickest, cheapest way to get this information into the public's hands." Mr. Flynn names CTA Tracker, Buster, and Busboy as popular options.

Mr. Flynn states that data collected for Train Tracker is similar to the Bus Tracker data, but that it is technology that uses the internal circuitry of the third-rail power line rather than GPS. Real-time schedule information is made available to the public on a website and through signs at each station.

The Bus Tracker/Train Tracker applications and the SMS messaging system have proven very popular, with robust downloads of several privately developed applications. Cold winter weather can bring as many as 100,000 hits on the Bus Time server every five minutes, and online reviews of the CTA's overall services are generally positive.

Figure 1. Chicago: New and Better Connections.




Source: Cisco Consulting Services, 2014

"We are the platform to enable innovation. We provide the data always enabled by an API."

Brenna Berman,
Chief Information Officer,
City of Chicago Department of Innovation and Technology

## Impact

### Department of Innovation and Technology

According to Ms. Berman, data collected by the city cover virtually every major area of operation. Mashing up and analyzing this data via the SmartData Platform provides a fruitful area for drawing conclusions and improving operations via predictive modeling, such as in the case of the rat infestation model and the WindyGrid dashboard.

Ms. Berman also indicates that the open-data initiative and the apps developed from it have had a positive effect, particularly in increasing resident engagement with the city. For instance, one application that utilizes city data was developed for free by civic-minded community members. The application takes GIS files of recent school closures and pairs them with crime data and business licensing data to map the safest routes for children to walk to school.

"I am never going to have the bandwidth, ingenuity, creativity, or insight into building all of the micro applications that every neighborhood in the city is going to want," said Ms. Berman. "I just couldn't do it, but the civic development community with grassroots commitment can."

This collaborative mind-set and approach has motivated another key facet of the SmartData Platform and the WindyGrid tool. Both have been created utilizing an open-source data infrastructure, meaning other metropolitan areas can utilize the technology to improve their operations as well. They can import the predictive models and adapt them to meet their own data analysis needs. By using an open-source approach, the City of Chicago is not only saving development costs and making future updates easier, but is also providing tools to improve the well-being of people in other cities.

According to Ms. Berman, "We are the platform to enable innovation. We provide the data always enabled by an API." While the city has vowed not to use the data to raise revenues, companies can monetize the applications and services they develop based on the city's data. City officials see this as a new economic development opportunity, cultivating a city-focused app development ecosystem.

### Chicago Transit Authority

Making Bus Tracker system data available for access by both public and private application developers has several benefits. Providing a common data feed of real-time information for smartphone apps, an SMS notification system, a dedicated website, and electronic signs at stops means that commuters receive consistent information and updates across all platforms. In addition, keeping the data available for open-market applications has saved the CTA the time and costs typically involved in developing and supporting an internally created application.

Mr. Flynn believes that improved customer service is the most important benefit of the Bus Tracker and Train Tracker systems, adding that "empowering your customers with information" is a "game-changer" in the industry.

According to Mr. Flynn, the location data provided by the Bus Tracker and Train Tracker systems provides advantages in transit management as well. Mr. Flynn gave an example of "bus bunching," the tendency for buses to congregate in bumper-to-bumper fashion, describing it as one of his industry's largest concerns, and saying the phenomenon is reduced by the new system. "Our long-term goal is to try to eliminate that to the extent possible," he said.

Bus location data allows CTA to address the issue via intervention with the bus drivers. "We've used this technology to build some webpages internally that we deliver," Mr. Flynn explained. "We have laptops and supervisor vehicles that are connected through a data modem, and the supervisors can see the street. We are trying to use this technology to bring visibility in real time to what's happening out on the street so that people can react to it and improve the service."

Mr. Flynn believes that improved customer service is the most important benefit of the Bus Tracker and Train Tracker systems, adding that "empowering your customers with information" is a "game-changer" in the industry. "It has made our customers more loyal to the product. It makes us more of a quality experience to the customer and, therefore, our customers ... have a higher opinion of our service quality."

## Lessons Learned / Next Steps

### Department of Innovation and Technology

The Department of Innovation and Technology is currently studying ways to use existing cameras for other types of measurements. While cameras were originally intended for monitoring traffic and safety issues, Ms. Berman says there is a wealth of other captured data that large cities like Chicago can use. "When it snows here, it does not snow evenly," said Ms. Berman. "It can be snowing in the north and not in the south .... One discussion we started to have is the roles cameras can play in determining the patterns and depth of snowfall in the city. The cameras essentially become a set of eyes wherever they exist. What can they tell us about the snowfall across the city, and how can we use that data to influence the deployment of snow

removals across the city? It's using that sensor in a different way from what it might have originally been deployed for."

While city officials see benefits in using video in new ways, one technical challenge is figuring out how exactly to process the video data. "The challenge right now, before we even get to the policy questions of using it, is technically processing video data," Ms. Berman stated. "There are technical challenges there that we are trying to address. How you structure that database is our challenge right now."

Another challenge for the city is how to use the data without infringing on people's privacy. Protecting privacy is of high importance in every area of data usage. "How do we anonymize that in such a way that we are protecting the privacy of our residents but still leveraging the usefulness of that data to improve city operations?" Ms. Berman asked. "I'm the steward of that data, but I don't own it. It belongs to the people of Chicago. They entrusted the city with the proper care and use of that data, but I need to protect it and ensure its proper usage within the proper privacy provisions of that data."

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## Chicago Transit Authority

Mr. Flynn describes the challenge inherent in any technological initiative as selling executive management on the costs of investment in the infrastructure. "[There is] the notion that, 'Why can't we be as nimble as the consumer market? Why does it cost $10,000 for a computer on a bus when I can go to the store and buy an iPhone for $400?' That's because Apple sold a billion of them. We're only buying 2,000. It's education and constantly communicating with people," he said.

Mr. Flynn describes another daunting aspect of the initiative as the pace at which public sector improvements tend to proceed versus the pace of technology. "The way that government procurements and funding operate, there are very long lead times," he said. "You have to issue RFPs, and those take time. By the time you come up with the idea, write it down, issue an RFP, get the responses from the vendors, and award a contract, the technology itself could already have evolved. The danger you have is that you've procured something based upon yesterday's technology. You're already obsolete before you've even started."

Mr. Flynn says that his planning strategy to address this includes "trying to future-proof these ideas so that you can take advantage of new technology capabilities when they come along, and you don't have to rip it all out and start over again; making sure that [components] can be broken apart and reassembled, so that the server operating system isn't dependent upon the database version, which is dependent upon the operating system version, which is dependent upon the network protocol." He said that he tries "to make sure that we've set things up so that if we get a cheaper cell-phone bill from another carrier, we can just swap out the modem and not completely reengineer all the software."

CTA attempts to present Bus Tracker and Train Tracker data in similar formats across websites and applications, although Mr. Flynn notes that bus data is GPS-driven and published to an API, while train location data presents a challenge in being gathered from third-rail circuitry, a technology that is decades old and not currently publishable to an API. He indicates that while CTA is in discussions with Google

 

Maps, and will soon provide Bus Tracker information in the required General Transit Feed Specification (GTFS) standard used by Google, negotiations for providing real-time train data are still in the future because of the way the data is structured.

Mr. Flynn also says the CTA Board of Directors recently approved a contract to procure a Computer-Aided Dispatch Automatic Vehicle Location system (CAD AVL), the industry standard for real-time vehicle management, and that CTA will be deploying this system in the near future. Mr. Flynn describes this system as installing a small-flat screen monitor on the dashboard of all buses to provide a live map of bus locations for each driver.

By summer 2014, commuters will be able to purchase fares using credit or debit cards at each station, or to use the NFC capabilities of smartphones directly at the gate.

"Now the bus operator will be able to see his or her leader and follower," he said. "They will be able to see where they are in relation to their schedule, where they are in relation to the rest of their fellow operators that are on the street. The control center will then be given a tool so that they can manage the street. The system will have some automated capabilities to send messages – stop, slow down, speed up, what have you – to the operator when the bus starts to bunch [with other buses] or there are big gaps."

Mr. Flynn describes other improvements currently taking place, including the installation of the Ventra open payment system. By summer 2014, commuters will be able to purchase fares using credit and debit cards at each station, or to use the NFC capabilities of smartphones directly at the gate. An additional mobile application will be created for Metra, a commuter rail agency in Chicago that is affiliated with – but not controlled by – CTA.

Mr. Flynn says that the Bus Tracker and Train Tracker program are continually in the process of being upgraded, and additional 4G capabilities are being worked into the systems. "We tweak them and enhance them based upon experience and feedback," he said. "They're constantly undergoing improvement and enhancement."

Both the Chicago Department of Innovation and Technology and the Chicago Transit Authority are working to improve residents' lives in Chicago by utilizing IoE technology and solutions. Per the city's Technology Plan, city officials, along with the private sector, are working to better connect Chicago residents and communities with the city's services, resources, and opportunities.

## More Information

For more information, visit http://www.cityofchicago.org

# Networking Academy Connects Students to Opportunities in the IoE Economy



**EXECUTIVE SUMMARY**

### Objectives

- Address broad issues related to employment and entrepreneurship; bridge global IT skills gap; empower students and educators

### Strategy

- Program develops and owns content, offering it to partner institutions free of charge, with deep discounts on equipment and certifications

### Solutions

- Cloud-based instruction, hands-on laboratory experience, interactive learning tools
- Cisco NetSpace – cloud-based platform that combines best-of-breed applications for teaching, learning, and collaboration
- Cisco Packet Tracer – customizable simulation platform allowing students to experiment with network behavior
- Instructor training, development, and collaboration
- Student assessments that enable ongoing course improvement

### Impact

- Financial mobility for graduates
- Economic and societal benefits from more skilled workforce
- Improvements in science of education and e-learning

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

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The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

 

## About Cisco Networking Academy

The Cisco Networking Academy® program was formed in 1996 when George Ward of Cisco approached the San Francisco School District about a pilot program teaching networking to students at Thurgood Marshall Academic High School. Mr. Ward brought on Dennis Frezzo and other young teachers to achieve the vision of merging Cisco's knowledge of networking with new teachers' knowledge of education. The first courses were offered in 1997.

Networking Academy™ has since grown to more than 9000 academic institutions worldwide. With more than 20,000 instructors trained to teach Networking Academy courses, more than 1 million students were expected to take courses from the academy in 2014. Participating academic institutions provide teachers and deliver the training, while Cisco provides the curriculum and training materials free of charge.

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A Networking Academy education focuses on developing ICT- and networking-related skillsets. Many students use the program to prepare for specific IT certifications such as Cisco CCNA®. Specific topic areas include network design, routing & switching, security, telephony, and cloud.

Alejandro Caballero is president of Universidad Tecnológica Emiliano Zapata (UTEZ) in Morelos, Mexico, which delivers the Networking Academy curriculum. A Cisco Certified Network Professional, he also holds a variety of additional specializations and certifications, and worked as an instructor at UTEZ before moving into administration. Mr. Caballero accepted appointments as academic secretary and director of information technology prior to becoming the president. He has been involved in the Academy from its inception in 2001, and assisted as it grew into both an Instructor Training Center and an Academy Support Center. Enrollment at his institution has grown rapidly – UTEZ expected 3400 students by September 2014.

Laura Quintana joined Cisco in 1999. As senior director of corporate affairs, Ms. Quintana is responsible for managing a global team and leading Corporate Social Responsibility field operations worldwide.

Dennis Frezzo joined Cisco in 1998. As a senior manager in Corporate Affairs, he is responsible for leading the Simulation, Game, and Mobile Engineering (SGME) organization, creating educational resources for the Cisco Networking Academy program. Dr. Frezzo previously worked as an optical engineer and taught high school for four years at what became the first Networking Academy in 1997.

## Objective

The academy provides critical technology education to help leverage and manage network technology infrastructure throughout the world, using that very network – via the cloud – to deliver the content. "We like to consider ourselves the world's largest classroom," commented Ms. Quintana. Furthermore, the academy teaches not just tech skills and certifications, but also entrepreneurial skills, and improves the curriculum continuously through a feedback loop between participants and Cisco.

 

Broadly, Networking Academy addresses big social issues – entrepreneurship and employment – and a global IT skills gap, while empowering individual students and educators.

## Strategy

The Networking Academy is Cisco's flagship corporate social responsibility program. Cisco develops and owns the program's content and platforms, which are provided to partnered academic institutions free of charge. For-profit universities are charged a nominal cost-recovery fee. The Network Academy program is offered in about half of the community colleges in the United States, as well as in public schools globally, from secondary to university levels.

The program provides e-learning courses, Cisco Packet Tracer, helpdesk support, instructor teaching guides and professional development, certification discount vouchers, and equipment discounts to educational institutions worldwide – approximately $200 million in value each year. When schools need to purchase equipment for hands-on experience, they receive significant discounts.

Networking Academy combines cloud-based instruction and a coordinated program of hands-on laboratory experience.

Mr. Caballero says that at his institution, a variety of public funding sources are leveraged to provide ongoing maintenance costs, primarily through the National Council of Science and Technology and the PROSOFT Fund.

## Solution

### Educational Structure

Networking Academy combines cloud-based instruction and a coordinated program of hands-on laboratory experience. Hardware kits containing switches and routers with IOS software are used for hands-on training modules. The real learning occurs through a host of interactive laboratory tools, which engage students. These tools include network and computer equipment, simulation software, WebEx video capabilities, Jabber collaboration software, and a social media platform that allows exchanges among students and instructors around the world. "Gamification" enhances the learning experience by offering games as optional learning platforms for further practice on real-world simulations. Three tracks of games have been released so far, including Aspire, an innovative educational game.

### Curriculum

Networking Academy's content delivery has evolved over its 18 years of development into the current, primarily cloud-based curriculum available on the Cisco NetSpace™ platform – a highly interactive and engaging learning environment that combines best-of-breed cloud-based applications for teaching, learning, and collaboration.

The curriculum starts with an introductory IT Essentials course that teaches PC hardware and software repair. Students can then progress to the Cisco CCNA curriculum, which consists of four courses, each containing 70 hours of material that can be delivered via Networking Academy's specially designed e-learning curriculum, a highly interactive, hands-on experiential learning platform. Other

 

offerings within the network professional curriculum include CCNA Security and Cisco CCNP®.

According to Mr. Caballero, all IT students at UTEZ go through the Cisco Networking Academy curriculum. “There are four subjects taught in the first, second, and third quarters, respectively,” said Mr. Caballero. Two other network technology courses are also taught: Convergent Networks (IP telephony, multi-layer switches, and networking design by hierarchy) and Security, which trains students on CCNA Security and prepares students for Cisco certification, if they desire.

According to Mr. Caballero, the UTEZ curriculum offers a variety of other certifications as well, and is being continually updated. Currently, students can earn certification in Cisco, Adobe, E-Carnegie, and Java. “The range of options gets broader all the time,” said Mr. Caballero.

The curriculum starts with an introductory IT Essentials course .... Students can then progress to the Cisco CCNA curriculum, which consists of four courses, each containing 70 hours of material that can be delivered via Network Academy’s ... highly interactive, hands-on experiential learning platform.

## Laboratories

Discounted lab equipment bundles (for hands-on lab experiences) are central to the NetAcad experience. These in-person hands-on labs are complemented by Network Academy’s simulation program Packet Tracer, a platform that allows students to experiment with network behavior through simulation, visualization, authoring, assessment, and collaboration capabilities.

Packet Tracer has a multiuser feature so users can communicate with others in the same local area network, or within TCP/IP socket connections over the Internet. The configurability of Packet Tracer allows instructors to customize courses directly for their own – or student – needs. Dr. Frezzo says this customization feature is tremendously beneficial because “content is taught by teachers at the local institutions, in their local languages, with their local cultural preferences,” giving students a quicker and more in-depth understanding of the material.

In UTEZ, says Mr. Caballero, “we have five labs – switching, routing, security, wireless, voice over IP – all based on Cisco servers.” He says that while technology partnerships are important in setting up initial infrastructure and training, “students can use any software from any manufacturer on a virtual machine.” Mr. Caballero’s school does not enter into outside contracts to maintain the technology. Labs are required to be self-sufficient and provide their own technical support through the school’s Academic Information Technology Office.

## Instructors

Networking Academy requires each participating institution to commit an instructor. Cisco supports instructor development with multi-tiered and ongoing training, available at the local Academy, Instructor Training Centers (ITCs), and Academy Support Centers (ASCs). ASCs have the capacity to serve a number of local academies, providing instructor training and equipment support. Some instructors in the program teach several subjects and are not necessarily networking experts, so the academy not only provides training, but also a vibrant instructor ecosystem to support them.Mr. Caballero stresses that qualifying certified professors as part of the training process adds a great deal of meaning to the training, as it helps motivate students to pursue similar credentials. “The role of the professor is key

 

to the program's success. The student realizes the importance of this training and certification because he sees that the instructor is certified," Mr. Caballero explained.

Mr. Caballero indicates that alumni often return to the school as instructors after years in industry jobs, keeping the training fresh with current, on-the-job techniques. "There are students who graduated from this university four or five years ago, who currently are professors," he said. "In other words, they went through the process as students, they got interested in the academic portion, and today they are among our professors."

Collecting data in the assessments has also revolutionized Network Academy's ability to update and improve course content in real time, as curriculum developers see areas where students may need additional information or support.

## Student Assessments

Accurate and ongoing assessment of each student's progress is also crucial to the education process. Networking Academy conducts 1 million student assessments per month. Performance is measured on a broad range of assignments, from chapter quizzes and final exams to hands-on simulations and labs. The psychometrically validated assessments provide student performance statistics that can be utilized by a student's institution to help assign student grades for the networking courses.

Collecting data in the assessments has also revolutionized Networking Academy's ability to update and improve course content in real time, as curriculum developers see areas where students may need additional information or support. An analysis of the data can show that a particular exam question is badly worded, for example, because students worldwide are answering incorrectly at a high rate. The value of these assessments extends even deeper, providing insight into the curriculum and the learning process. For example, an analyst can look at how students make their way through the curriculum and make adjustments to help people shorten their time to mastery. "We have incredible metrics on how our students are doing," says Dr. Frezzo. "We're always trying to do better. To me, this holistic approach to education is vital. We're really proud of the assessment piece."

## Entrepreneurial Development

Entrepreneurial skills are critical to Networking Academy's curriculum, so students are not only better prepared with employable skills, but equipped to become the creators of new businesses. A recently released course on entrepreneurship has been built from actual case studies.

"We anchor our focus on entrepreneurship relative to individuals with technology skills," says Ms Quintana. "We see that as our niche: technology-enabled entrepreneurial skills so that individuals can learn how to go about starting a business and leveraging their skills to charge for their services."

 

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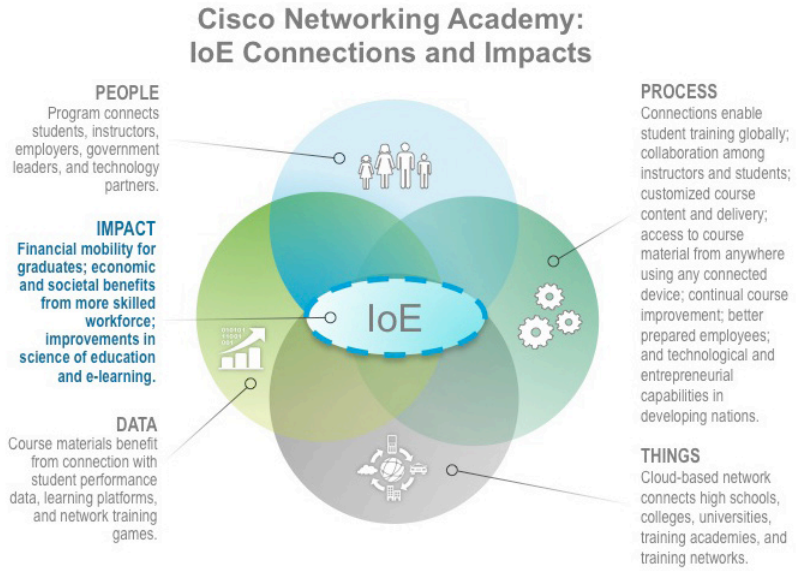
Laura Quintana,
Cisco Senior Director of Corporate Affairs

Figure 1. Cisco Networking Academy: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

The impact of Networking Academy is threefold. First, benefits accrue to individual graduates of the program in terms of financial mobility. Second, communities benefit from the economic and societal contributions of a more skilled and entrepreneurial workforce. Third, Networking Academy's analysis of student test data and performance has impacted the science and practice of education – especially an understanding of how to optimize e-learning.

### Student and Institutional Benefits

Networking Academy currently trains 1 million students per year globally, and its graduates benefit from economic mobility. In exit surveys of students completing courses through Cisco CCNA4 or higher, 52 percent of respondents reported that participating in Networking Academy led to landing a new job; 72 percent obtained some type of job opportunity (a new job, a better-paying job, or increased responsibilities); and 92 percent attributed a job and/or additional education opportunity to their participation. Cisco Networking Academy has contributed to 1.2 million Cisco CCNA students obtaining a new job based on a post-stratification analysis of exit surveys from 2005 to 2013.

According to Mr. Caballero, "Every young person who has been certified in our program has been hired, either by a telecommunications firm or an information technology company." UTEZ graduates' success is quantifiable: Mr. Caballero estimates that a UTEZ graduate who is hired by either of those two types of companies can make at least 50 percent more than non-IT graduates or IT graduates who go to other types of employers. Their salaries are also higher

The program's success has also bolstered UTEZ's reputation as a university that builds careers, driving ever-increasing enrollment. "We have become a point of reference, a model institution in the way we're structured as well as in training and certification," Mr. Caballero explained. UTEZ has a powerful presence in supporting the Mexican government's initiative to improve Internet connectivity nationally, and was selected to operate the initiative for its home state of Morelos, in which 4637 public sites will be wired for free public Internet connectivity.

## Societal Benefits

Next, Networking Academy broadly benefits society. In terms of hard cost savings, Networking Academy provides instructor training, e-learning licenses, and job training for students – all at no or reduced cost, saving governments and schools millions of dollars. In terms of value generated, Ms. Quintana explained, "We're helping to address an issue, a challenge in education – helping to prepare individuals with workforce-ready skills," she said. Citing the case of France, Ms Quintana said that a research firm hired to evaluate the program concluded that Networking Academy is, at a minimum, contributing 35 million euros a year in economic impact to France. The economic impact extends to French civil society as a whole in terms of faster re-integration for vocational students and the long-term unemployed; improved tax and national insurance contributions from quickly placed graduates; lowered costs to academic institutions; and higher salaries to graduates.

A research firm hired to evaluate the program concluded that Networking Academy is, at a minimum, contributing 35 million euros a year in economic impact to France.

## Educational Benefits

Finally, in its nearly two decades of educating IT students, Cisco Networking Academy has made significant advancements in understanding what makes for successful e-learning content and delivery.

One key component of running a successful e-learning platform has been the high quality of the instructors. To facilitate their training, Networking Academy instructors collaborate with colleagues from around the world. "We have communities that the instructors can join," said Ms Quintana, "so if you are an instructor teaching CCNA in South Africa, you could be interacting with a community of another 10,000 instructors around the world who are also teaching CCNA. You can share best practices, share learning guides, share videos. The impact of that network alone is phenomenal from an educational perspective."

According to Dr. Frezzo, Networking Academy is unique because it doesn't just teach a subject – it has built a community. "Colleagues and friends of Networking Academy contribute to their communities in a lot of ways," said Dr. Frezzo. "Probably, humbly, we've helped interconnect them. They were going to do great things without us, but – thinking of the Internet of Everything slogan 'connecting the unconnected' – this program has given them a vehicle for their professional aspirations. A lot of instructors have been very innovative, building programs around Networking Academy to help people we at Cisco never by ourselves could have reached. That is what happens when you connect things."

## Lessons Learned / Next Steps

Mr. Caballero lists instructor certification, well-equipped labs, and mastery of English as key elements of UTEZ's growth and success. He now devotes his time to increasing the capacity of the school to meet demand, and expects full enrollment of 3400 students by September 2014. "Every day we work to obtain more resources that would allow us to receive more students," he said. "With good management and efficient use of resources, we will be able to respond to the expectations of our students. This doesn't keep me awake, but it keeps me busy."

"Every day we work to obtain more resources that would allow us to receive more students. With good management and efficient use of resources, we will be able to respond to the expectations of our students. This doesn't keep me awake, but it keeps me busy."

Alejandro Caballero,
President,
Universidad Tecnológica Emiliano Zapata

Another important success factor for UTEZ is having a strong partner ecosystem. UTEZ has the trust of students and professors, support from the authorities and governments, and a broad alliance of IT vendors providing the Networking Academy's infrastructure and labs. "We have never had an adverse scenario," said Mr. Caballero. "Quite the opposite. Even though it is not easy, with efforts of all — contributors, partners, and employees — this university has been improving, growing, and becoming stronger."

Cisco has come across occasional negative views of corporate involvement in education. "I think some academic institutions, or some government leaders, might suspect our intent," said Ms. Quintana. "They think we are pushing vendor-based training." Cisco has countered these concerns by educating institutional and governmental leaders that Networking Academy not only teaches how to support Cisco equipment, but IT in general in a vendor-neutral manner; students learn Internet protocol theory and standards.

According to Dr. Frezzo, the biggest challenge is staying current with independent educational institutions' curriculum criteria and standards, and balancing the objectives of various participants. Ironically, Networking Academy's ability to update and improve content and course delivery is so dynamic that it moves faster than the rest of the system. "There's a tension, because educational institutions, for a good reason, have a diverse set of inertias. To ensure quality at local institutions, they have curriculum review boards, and you have to respect their processes. If you change the content too much, you risk invalidating the course approval across schools, or you don't have enough data to prove whether the new assessment items are performing well." Networking Academy also has to answer to Cisco and students. As Cisco, Networking Academy wants students to pass certifications. As an educational program, it needs to put students' overall education first, and to prepare them for the next step, whether it be networking, entrepreneurship, or innovation.

Another challenge revolves around Networking Academy's trial initiative to integrate games into the educational process. Because the games are released as optional learning materials to enhance abilities, Dr. Frezzo says the amount of pressure for students to be ready for certification and grades does not give them the time to take advantage of the resource. Dr. Frezzo says Networking Academy is experimenting with combining a truly game-like atmosphere that also allows for student assessment. "We're really experimenting with learning the line between game practice and what we call formative assessment, which gives you a little feedback,"

As for next steps, Networking Academy is developing a set of courses ranging from completely online to in-person classes focused on the Internet of Everything, and training students for the Internet of Everything marketplace.

Dr. Frezzo said. He explains that the right balance is when the student realizes, "Oh, right. That was an assessment, but it was fun."

As for next steps, Networking Academy is developing a set of courses ranging from completely online to in-person classes focused on the Internet of Everything, and training students for the Internet of Everything marketplace. "We want to continue to innovate and make sure that our curriculum is relevant, so this will continue to be a big investment area for us," said Ms. Quintana. Even with the progress made, there is still a skills gap where supply is not meeting market demands. To address this, Networking Academy is working on employment initiatives that will connect students and employers in innovative ways, bringing together workplace needs with candidates' skills.

Another area in development is improved performance assessment, with the goal of determining which job skills are truly transformative. Those skills can then be given more emphasis in the curriculum. "What you can do now with online assessment, online intelligent tutoring systems, online games – those capabilities are barely touched upon in education today," Dr. Frezzo explained. "I think it will really grow in the next couple of years."

## More Information

For more information, please visit http://www.netacad.com

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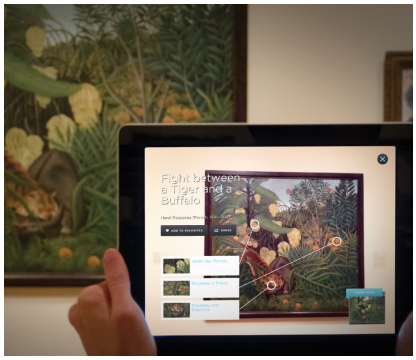
# IoE-Driven 'Gallery One' Boosts Attendance and Repeat Business for CMA






## EXECUTIVE SUMMARY

### Objective

- Leverage Wi-Fi, handheld mobile devices, high-resolution displays, and interactive digital technology to create a vibrant, interactive, and personalized exploration for each museum visitor — and to reach those not typically drawn to museums

### Strategy

- To secure buy-in and support, use prototypes to help museum executives and board members understand what the technology could accomplish
- Assemble profiles of museum's current visitors to identify appropriate solution
- Leverage the digital catalog and photography of CMA artworks to build a base for multichannel publishing

### Solution

- Technological renovation of museum experience incorporates interactive digital and mobile technology to bring visitor engagement to a new level
- Gallery One offers 10 interactive experiences including the Collection Wall, a 5- by 40-foot multitouch display made up of 125 Christie MicoTiles
- ArtLens mobile app provides visitors with interpretive information about each artwork on view

### Impact

- Boosted attendance by 39 percent
- Increased family visitors to 29 percent
- Stronger repeat business to Gallery One

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases — how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions — federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) — to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Cleveland Museum of Art 'Gallery One'

The Cleveland Museum of Art (CMA) recently completed a $320 million renovation project featuring a technological boost to the museum experience, and incorporating interactive digital and mobile technology to bring visitor engagement to a new level. At the entrance to CMA's newest addition, Gallery One, visitors are drawn in by a beacon to a hands-on space with nine interactive experiences, including the Collection Wall. The 5- by 40-foot Christie MicroTile multitouch display features works on view from the museum's permanent collection, and lets patrons create individualized tours of their favorite artworks.

A custom-made app, ArtLens – available for iPad, iPhone, and Android – lets visitors carry their Gallery One experience throughout the rest of the museum. ArtLens engages visitors with multimedia content, providing interpretive information about select pieces of art, as well as descriptions of each artwork on view.

Additional interactives, including three especially for young children, use a gaming approach to engage patrons in exploring the museum's artworks and explaining how and why they were created.

The aim of the project was to leverage Wi-Fi, handheld mobile devices, high-resolution displays, and interactive digital technology to create a vibrant, interactive, and personalized exploration for each museum visitor, and to reach those not typically drawn to museums.

Since its debut, Gallery One has attracted the notice of visitors and museum administrators around the world.

Jane Alexander is chief information officer for the Cleveland Museum of Art. Previously, she worked as the virtual chief technology officer for the Great Lakes Science Center, and as a technology design consultant to Frank Gehry's Peter B. Lewis Campus at Case Western Reserve University.

## Objective

Ms. Alexander led a cross-functional technology team of vendors and staff that developed Gallery One and the ArtLens app for the Cleveland Museum of Art. Fueled by a $10 million grant from the Maltz Family Foundation, a new space came to life within the museum that incorporates cutting-edge technology and art in a way that brings the museum experience to a modern audience. The aim of the project was to leverage Wi-Fi, handheld mobile devices, high-resolution displays, and interactive digital technology to create a vibrant, interactive, and personalized exploration for each museum visitor, and to reach those not typically drawn to museums.

## Strategy

Ms. Alexander indicated that the museum has been very open about what it has done. "We believe in sharing information with other museums, and contributing back to that community," she said. "I publish everything. I keep everything open. I let people know exactly how we did it, because we don't need to keep secrets. We're continuing to grow and push and make calculated risks to use innovative technology to serve up the museum experience in multiple ways to multiple types of visitors."

In the initial development phase, prototypes were critical to helping the museum's executives and board members understand what the technology could accomplish, and how visitors would interact with it. This was crucial in getting buy-in and support.

First steps for the project included assembling profiles of the museum's typical visitors, which revealed a desire for more information about the artworks, the need for more children's activities, and a perception of a museum as a "quiet, stuffy place."

Taking advantage of the quality of the museum's collection and its up-to-date digital records, Ms. Alexander's implementation team took advantage of CMA's robust content management system (CMS) and digital asset management (DAM) to track each artwork and its associated information, and to layer all subsequent programs on this platform to "let the collection speak for itself."

The most ambitious interactive in Gallery One is the Collection Wall, a constantly changing 40-foot Christie MicroTile multitouch display featuring art currently on view from the museum's collection.

## Solution

Ms. Alexander and her project co-leaders — Caroline Goeser, director of education and interpretation; and Jeffrey Strean, director of design and architecture — oversaw the realization of that vision when Gallery One opened to the public in January 2013. It combines a state-of-the-art orientation center and an educational forum, giving visitors a vibrant introduction to the museum. Gallery One introduces each patron to CMA's excellent collection with nine high-resolution, interactive stations. The ArtLens app then guides them throughout the rest of the galleries via curated tours or custom tours based on the patron's chosen favorites.

The most ambitious interactive in Gallery One is the Collection Wall, a constantly changing 40-foot Christie MicroTile multitouch display featuring art currently on view from the museum's collection. While browsing categories such as genre, medium, or most popular pieces, visitors can choose their favorite artworks, which are then downloaded to their iPad, iPhone, or Android device. Preloaded devices can also be rented from the museum. The project team designed ArtLens to guide visitors to each desired work of art, and to present relevant and interesting information utilizing a Wi-Fi connection. The user can access historical data, interpretive information, and other interesting facts about each piece. Information is delivered in a variety of multimedia formats. Additionally, as they roam the galleries, visitors can scan selected artworks with their device's camera to access further content, including videos and curator talks.

### Content and Digital Asset Management

Ms. Alexander found much of what she needed for both the Collection Wall and in the ArtLens application in the museum's existing system of records, a comprehensive compilation of digitized photographs and information on every item in CMA's vast collection. This included descriptive information such as the date of creation, genre, and medium; interesting historical facts, such as cultural influences and accession history; and stunning photography of the artworks.

Wanting to "let the collection speak for itself," Ms. Alexander pushed to leverage the artwork images and descriptions already available in the museum's DAM system, and use that repository as the core of all artwork-related public access. The idea was to "put this work into a digital strategy," she recalled. "Then, whatever the need is, however technology changes going forward, we would be able to publish and share our artwork from a solid base." Videos, slideshows, comparative images, interpretive text, and dozens of predefined tours were loaded into an optimized content management system, which is fully integrated with the core DAM.

Ms. Alexander's decision to use the DAM system as a platform on which to build the remaining information systems was crucial in many ways. One advantage is the way it provides for real-time updating of information across all systems. "Developing content takes a time and intellectual effort," Ms. Alexander explained. "We're using that content in multiple ways. If you create or change something once and it goes to all the other places, you're working smarter. Otherwise, you'll never be able to keep up with all the information out there, and things will be outdated and not current. Visitors need to know they're getting accurate, timely information.

The team envisioned Gallery One as an orientation center that provides visitors with toolsets that help maximize their museum experience.

"Gallery One became a test bed for our digital strategy that the tech team can log into [from] any machine, from anywhere," she continued. "We do it all the same way – the same way our seminar rooms and our boardroom have been set up – so that you're not switching technology each time you walk into a new space. When we do something big, we know how to change it throughout the entire museum."

Wanting to provide a rich audiovisual experience, one of Ms. Alexander's first steps was hiring an AV integrator to help guide the project, which assisted both the quality of the final product and the bottom line. "I wanted an AV integrator from the beginning," she said, "because I still believe that while designing the technology, you needed to be thinking how you're going to implement this – how the visitor will act and react to it. When designing interactives, you also need to be thinking about the analytics you want to capture, because it costs much more to add analytics tracking afterwards."

## Interactives

The team envisioned Gallery One as an orientation center that provides visitors with toolsets that help maximize their museum experience. Gallery One's nine stations incorporate interactive education through a high-resolution visual tour of the museum's extensive collection. Six stations are designed to educate patrons in various aspects of art, such as portraiture, sculpture, symbolism, narrative archetypes, geography, cultural influences, and artistic motivation. Three stations were designed specifically for families with young children, although they have proven widely popular among all ages. "There are many Fridays and Wednesday nights we're open late, and it's only adults there with no kids anywhere in sight," Ms. Alexander noted.

The showpiece of Gallery One is its Collection Wall, which presents an ever-changing display of more than 4,100 works of art in CMA's collection. At 5 by 40 feet, it was the world's largest Christie MicroTile multitouch installation at the time Gallery One opened. The wall is a magnet for visitors, who can interact with the

artwork and easily select their favorites. When they leave the Collection Wall, their favorites are downloaded to the ArtLens application, and their customized, guided tour begins.

## ArtLens

In the development of the ArtLens mobile app, Ms. Alexander's media designers conducted significant research to determine popular features from other successful applications. "A seamless-as-possible interface design is really important, using best practices," she said. "We looked at how iTunes did it. We looked at how Facebook mentioned to go to another page. We looked at things that people use all the time to determine the real current practices of how people get in."

"A seamless-as-possible interface design is really important, using best practices. We looked at how iTunes did it. We looked at how Facebook mentioned to go to another page. We looked at things that people use all the time to determine the real current practices of how people get in."

Jane Alexander,
Chief Information Officer,
Cleveland Museum of Art

One of the first challenges needing to be addressed in the ArtLens development was way-finding: the technology that detects visitors' locations, guides them through the tour, and delivers targeted content. Because much of the Wi-Fi infrastructure within the galleries had been previously installed in a manner not conducive to location tracking, the museum had to find an alternative solution for indoor triangulation technology. The Museum solved this by bringing in an outside partner for a hosted solution. The partner worked closely with the museum and app developers during implementation, and made several customizations to their system to meet the museum's particular needs.

The museum team also requested image-recognition capability within the ArtLens app, both for the "ooo-ahhhh" factor and to make the app an activity. "We've used augmented reality, so that when you see an artwork you like as you're wandering, you just hold up your device and hotspots pop up with information or videos," Ms. Alexander said. Users may also choose from dozens of curated tours that highlight prominent artworks and themes.

Although the Christie MicroTile wall and other software is Windows-based, Ms. Alexander selected Apple hardware as the platform of choice for the initial rollout of the ArtLens application, both for the high-resolution display and because research indicated that up to half of the museum's patrons were likely to own Apple products. "Your iPad, iPhone – and now, your Android device – connects to the collection wall through RFID," she explained. "When you come to the museum for the first time, we give you RFID capability for free, and we set up your device. It takes only two minutes. Then every time you come, you can connect to the wall and keep exploring."

Estimating that 20 to 25 percent of visitors would arrive with their own device, Ms. Alexander authorized the purchase of enough iPads to rent to remaining visitors. The museum's research team discovered that more than 55 percent arrived with their own devices. The tech-desk ran out of RFID tags much faster than rentable iPads. "People were actually buying an iPad before they came, just to do the experience from their own device," said Ms. Alexander. "We did notice that people are comfortable with their own device. When the phone versions rolled out, our budget for RFID tags really jumped because people really want to use their own devices."

Another aspect of the ArtLens design is the ease and security with which guests can share the experience with friends. Research suggests that 70 percent of museum visitors are likely to take and share pictures of art, and themselves with art. This activity continues to be very popular, particularly among guests with their own hardware. "People love doing that, having a way to share art easily from their own device," said Ms. Alexander. "People don't like to log in to their social media or to give you a personalized email or anything; they're cautious. We wanted to let you get into the interactive without having to provide any of that."

"You don't want to have something that feels dated – or, worse yet, broken – as soon as you roll it out. Our back end is both scalable and sustainable. That was a huge part of it. Every piece of hardware in Gallery One can be replaced within a minute. For example, you don't have to turn off the wall just to replace a blown MicroTile."

Jane Alexander,
Chief Information Officer,
Cleveland Museum of Art

## Website

Ms. Alexander made an early decision to change the platform of the museum's website to an open-source option, after finding the previous platform to be insufficiently customizable. "It did not take into account the dynamic collection," she said, "so we migrated the entire site to provide a flexible and extensible platform for development and integration." The website had to show the same artworks on view as the Collection Wall and ArtLens, and had to provide an online "landing" site for visitors to share favorite artworks with friends. The information for ArtLens' calendar of the day's events comes directly from the public website, but with its own look.

In each of her technological choices, Ms. Alexander kept this long-term perspective by selecting those she felt would be easily maintained and upgraded. "You don't want to have something that feels dated – or, worse yet, broken – as soon as you roll it out. Our back end is both scalable and sustainable. That was a huge part of it. Every piece of hardware in Gallery One can be replaced within a minute. For example, you don't have to turn off the wall just to replace a blown MicroTile."

**Figure 1.** Cleveland Museum of Art: New and Better Connections.


Source: Cisco Consulting Services, 2014

## Impact

The debut of Gallery One had an immediate impact on both the local public and the larger museum community, according to Ms. Alexander, positioning the Cleveland Museum of Art as a must-see destination for those visiting the area. "It's been very well received, more than I think anyone ever thought it would be," she said. Since it opened to the public in January 2013, attendance has risen 39 percent, with family visitors increasing to 29 percent, and repeat business for Gallery One is robust.

"It seems like it's a commercial in that space all the time, with kids running to the wall and saying, 'Mom, you're right, museums aren't boring!'" Ms. Alexander said. "I think people are engaged – it does encourage people. Every time I'm down there, someone's telling me how much they love it."

The project has garnered the museum official recognition, including four MUSE awards for Gallery One's outstanding interactive experiences. Local and national press, and those in the museum industry, visit the museum regularly to see the experience for themselves and learn more.

Since it opened to the public in January 2013, attendance has risen 39 percent, with family visitors increasing to 29 percent, and repeat business for Gallery One is robust.

## Lessons Learned / Next Steps

Just a year after its debut, Gallery One is still widely examined by both CMA leadership and the museum community in general to determine why it works so well. Ms. Alexander remains watchful for ways to improve, and mindful of the big picture. "CMA is doing a huge evaluation on the whole experience now, and I've been putting my energy into codifying a museum-wide digital strategy," she said.

For other museums hoping to create a similar experience, Ms. Alexander advises the creation of hubs that allow easy exchange of data across various software systems. "There's no system that's going to do everything for everyone, so looking at designing systems that can easily talk to each other, open architecture is key. We're working right now on a project that pulls together information from our donors and members, our ticketing, our parking kiosks, and our store, so that each of these different venues can easily see comprehensive information on our member-visitors that they couldn't get otherwise because they're using their own software."

Ms. Alexander also has ideas for an application that allows a similarly smooth exchange of information among museums. "I want my data out there to always be current. [The challenge is] figuring out a back end, so that when there's an exhibition that travels from the Getty to Cleveland to the Met, the audio guide is replaced with this app that can pull information from all three different museums easily. It's a sort of standardization. The other thing that I see happening more is location – I mean, everyone is doing Big Data and the Internet of Things, but it's about how you manage all this data through all these different devices, and how information, depending on where you are, will be brought up to you."

In addition to examining the way art information is offered to the visitor, CMA's research department also collects and analyzes data on the visitors themselves, and continues to look for creative sensors to collect this data. "I think that's really important – understanding exactly where visitors are going," she explained. "We're

Ms. Alexander encourages museums seeking to produce a similar in-house app to consider the way worldwide access might affect its distribution.

doing it through studies, and we have little video cams with people, where they're going and how they're using their app and things like that. In looking in the whole Internet of Things approach, it's really the sensors, mobile devices, and where they are that is going to be really important to getting the right information to people and changing the experience."

When Ms. Alexander studied download data for the ArtLens app, she was surprised at its worldwide popularity and felt the app was unprepared for this. "When we were designing ArtLens, we decided we were designing it for the in-house experience," Ms. Alexander said. "But when we looked at the analytics, about 65 percent of the people that download ArtLens are nowhere near Cleveland, and most likely are not coming to Cleveland. We have it so that the person who's coming here can do stuff at home and then come the next day, but we didn't think about the person who's never coming here."

Ms. Alexander encourages museums seeking to produce a similar in-house app to consider the way worldwide access might affect its distribution. "You might make decisions, but you have to think about [the possibility that] the audience might choose not to use it that way. Even with language, we decided, Cleveland is not a global tourist destination yet. We don't need to worry about other languages. But 35 percent of the people [downloading ArtLens] are across the world, and maybe we should think about other languages." The issue, then, is which languages?"

## More Information

For more information, please visit http://www.clevelandart.org/gallery-one

# IoE Capabilities Help Delaware Deliver Award-Winning Cybersecurity and Disaster Recovery Training



**EXECUTIVE SUMMARY**

### Objective

- Establish information security and continuity-of-operations governance plan for every state agency to protect against all threats, including data security breaches

### Strategy

- Instituted extensive employee training, outreach, and education
- Applied uniform security strategy across all state governments

### Solutions

- Online cybersecurity training program that is required of all Executive Branch employees
- Critical disaster recovery and continuity-of-operations planning initiative
- Specialized training events, including Cyber Security Conference and Cyber Security Exercise
- Certification programs for state's ISOs
- Penetration tests assess each state agency's preparedness to deal with possible cybersecurity attacks

### Impact

- Number of incidents has dropped measurably as Education and Awareness program has matured
- Delaware is considered on the forefront of cybersecurity awareness, and has been recognized with a number of official awards and designations from the government and third-party organizations

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About the State of Delaware

The state of Delaware has established an award-winning data security initiative to educate and train all state employees to recognize and respond appropriately to cybersecurity threats. It employs a uniform system of training, including monthly and annual events, security certification programs, cybersecurity breach simulations, and online education programs. Additionally, the state runs an active disaster recovery and continuity-of-operations planning program to help anticipate and prepare for cybersecurity threats.

"We had a really good focus on security ... but it was tactical and technical. We had the right firewalls in place, and antivirus tools and other technologies to keep us secure. What was missing was the holistic view. We didn't have many policies on the books. We didn't have any type of formal education and awareness of state employees. We had limited attention on business continuity and disaster recovery."

Elayne Starkey,
Chief Security Officer,
Delaware Department of Technology and Information

Chief Security Officer Elayne Starkey oversees the Delaware Department of Technology and Information (DTI) Security Office. Under the direction of Delaware's General Assembly and the governor, DTI services all state organizations, including the legislative, judicial, and executive branches, public schools, and various other governmental agencies.

Ms. Starkey works closely with DTI Chief Information Officer Jim Sills and the governor's office. Her team is responsible for the design and execution of the Delaware Information Security Program and the Continuity of Operations and Disaster Recovery Program.

Ms. Starkey became DTI's CSO in 2006 after serving a number of years as the state's chief technology officer, and as chief information officer for the Delaware Department of Public Safety. Ms. Starkey has private-sector software engineering experience at Xerox Corporation.

## Objectives

In 2009, Delaware's governor issued an executive order requiring every state agency to establish a continuity-of-operations plan for protection against all threats, including data security breaches. Ms. Starkey described the state's previous program: "[We] had a really good focus on security ... [but] it was tactical and technical. We had the right firewalls in place, and antivirus tools and other technologies to keep us secure. What was missing was the holistic view. We didn't have many policies on the books. We didn't have any type of formal education and awareness of state employees. We had limited attention on business continuity and disaster recovery."

## Strategy

In response to the enterprise data breach security and prevention plan, Ms. Starkey instituted a plan of extensive employee training, outreach, and education. She sought to establish "a 50,000-foot view" across all state government and to apply a uniform security strategy "holistically – not just in our department, but across all state government."

Ms. Starkey indicated that the overall budget for DTI is $39 million, which includes IT infrastructure and software costs. She estimates that 2 to 3 percent, or approximately $1 million, of that budget is earmarked for security training and administrative expenses.

## Solution

### Cybersecurity Education and Awareness

One of the first steps was to establish a cybersecurity training and awareness program for all employees. This training provides employees with insights on how to avoid cybersecurity risks and vulnerabilities. It includes specific, actionable guidelines such as scanning files before opening them, best ways to avoid phishing attacks, and not clicking on suspicious links in an email.

State employees receive cybersecurity training annually, in addition to when they are first hired. Training to date has included the state's 15,000 Executive Branch employees, 18,000 K-12 school district employees, and special in-depth training for the state's 230 information security officers (ISOs). According to Ms. Starkey, the chief justice of the Delaware Supreme Court also recently mandated increased data security training for all Judicial Branch employees. Ms. Starkey termed education and awareness training the "cornerstone" of Delaware's "very aggressive outreach program."

"We recognize that they are not in the business of information security like we are, but it's the little things that they do every day while sitting at their computer, or handling paperwork, or handling thumb drives, laptops, and mobile devices, that really do make a difference in the security of our network."

Elayne Starkey,
Chief Security Officer,
Delaware Department of Technology and Information

The training is delivered via a 45-minute course, which includes instruction, quizzes, threat examples, and other content. Users move through at their own pace. According to Ms. Starkey, the training has more than 30 modules that are rotated each year to address specific challenges or threats. These modules include subject matter such as mobile device protection, social engineering, and staying clear of viruses. In addition, each agency can opt to include agency-relevant modules, such as a HIPAA module that the Delaware Department of Health and Social Services uses to train employees dealing with sensitive medical records.

The training modules enforce basic security procedures for daily operations. "We recognize that most employees are not in the business of information security like we are, but it's the little things they do every day while sitting at their computer, or handling paperwork, or handling thumb drives, laptops, and mobile devices, that really do make a difference in the security of our network," Ms. Starkey explained.

One particularly informative aspect of the training is regular "phishing" exercises conducted by DTI. "We carefully craft an email that looks like a phishing attack, but it's all coordinated through our office. It invites employees to either open an attachment file or click on a link," Ms. Starkey said. "If they do click, they are immediately presented with an education screen that says, 'Oops. We were hoping you would not click on that link. Here are all the reasons you shouldn't have clicked.' That's been very useful to give me some real meaningful metrics to measure how closely our employees are paying attention to all the education and awareness that we're sending their way."

To supplement this outreach, DTI also manages a scorecard program where ISOs in each state agency and school district are surveyed about their cybersecurity practices. Ms. Starkey explained: "We do this on a biannual basis. They complete a survey, which results in a numerical score and a one-page management-friendly Information Security Scorecard." Results are provided to both Information Security Officers and their senior managers.

To accommodate the growing need for trained data security professionals, Ms. Starkey's office also partners with the Cyber Aces program. This organization sponsors events and competitions encouraging youth to pursue education and employment in data security fields. Delaware is one of the first states in the United States to host Cyber Challenge Camps and Cyber Aces Competitions to attract young people to pursue a career in information security. The state also hosts an annual statewide cybersecurity training conference for state, local, county, military, and private-sector employees. Each year, state employees and outside partners also spend time in elementary schools educating students about Internet safety principles.

## Business Continuity and Disaster Recovery Plans

In response to a directive from the governor, Ms. Starkey's team also assumed responsibility for assisting each state agency in establishing an all-hazards continuity-of-operations plan for protection. "My team is responsible for getting out there and working with each state agency to assist them in the preparation of their plan," Ms. Starkey said. Her work has included Executive Branch agencies, the Department of Education, and the Judicial Branch.

"Every plan is prepared in a consistent way so that in the event of some large-scale disaster, we could readily get to the COOP plans and provide information to decision makers in the midst of a disaster."

Elayne Starkey,
Chief Security Officer,
Delaware Department of Technology and Information

Initially, DTI worked with the Delaware Emergency Management Agency to identify "tier-one agencies," which are, according to Ms. Starkey, those that, if they could not deliver services, would risk either loss of life or significant property damage. Currently, plans have been completed for all tier-one agencies, and they have nearly finished plans for the tier-two agencies as well.

According to Ms. Starkey, these plans are crucial to state operations. "Every plan is prepared in a consistent way so that in the event of some large-scale disaster, we could readily get to the COOP plans and provide information to decision makers in the midst of a disaster."

"We have a consistent, repeatable methodology that the team developed and tweaked along the way," Ms. Starkey indicated, adding that her team has been recognized for their efforts. "Last year, Governor Markell presented this team with the Governor's Team Excellence Award, and they have also been recognized by Disaster Recovery Institute International with the 2012 Strategy of the Year Award."

## Conferences and Training Events

Ms. Starkey's team organizes specialized training events throughout the year, which she describes as "key parts of our Education and Awareness." She also hosts two large-scale training events: the Cyber Security Conference for both public and private representatives, held each spring; and the autumn Cyber Security Exercise for government employees. She and her colleagues create a large-scale cybersecurity breach simulation, in which participants practice emergency plans, including detection, remediation, and recovery techniques.

## Certification Programs

Ms. Starkey offers certification programs for the state's ISO team: 230 information security officers consisting of one or two representatives from each area of state government. While establishing elements of the program, Ms. Starkey discovered

that the ISO program's existing education was outdated and did not take into account "how the world has changed in the last seven years." She noted, "Security wasn't such a headline then as it is today. It didn't require a lot of attention."

To rectify this, Ms. Starkey encourages ISOs to obtain their CISSP certification, which Ms. Starkey termed the "gold standard" in worldwide information security training. While the certification is voluntary, DTI actively supports the program, providing a week-long "boot camp" opportunity for each ISO. "We've asked them to step up in a major way, and I am not a big fan of asking our employees to step up without offering training to go along with that," she said. The camps are run with the assistance of (ISC)2, a professional certification organization, and the University of Texas. "This prepares the students to sit for the exam to achieve their certification," Ms. Starkey said.

The program was recently awarded the Cyber Innovation Award from the SANS Institute. In addition, Governor Markell has been highly supportive of the DCISO program, inviting those receiving the certification to his office for a recognition ceremony and presentation of credentials.

Ms. Starkey and her colleagues instituted an additional certification training program for Delaware public employees: the Delaware Certified Information Security Officer (DCISO) designation. This program is conducted through a series of online training courses and other activities, including various electives such as helping with exercises or doing presentations at regular ISO meetings.

Employees enrolled in the DCISO training receive credits for each area completed, which Ms. Starkey described as "an incentive program in its simplest form, something to aspire to and to demonstrate to their management how seriously they are taking information security." The program was recently awarded the Cyber Innovation Award from the SANS Institute. In addition, Governor Markell has been highly supportive of the DCISO program, inviting those completing the certification to his office for a recognition ceremony and presentation of credentials. Ms. Starkey described the executive-level support as "huge" for her department in motivating employees.

Additionally, Ms. Starkey indicated, "Throughout the year, we offer other types of training for our information security officers, and technical training for the IT staff."

## Penetration Tests

Ms. Starkey described her agency's efforts at conducting penetration tests as an important way to assess each state agency's preparedness to deal with possible cybersecurity attacks. These tests involve simulated attacks orchestrated by DTI staff in conjunction with trusted vendor partners. Because Delaware's IT network is highly centralized, it is relatively easy for DTI to conduct such tests and to monitor and analyze results.

Ms. Starkey indicated that DTI will oftentimes conduct such tests or deeper analysis activities with agencies that did not score particularly well on the annual scorecard exercise. This is helpful in identifying and addressing vulnerabilities that might affect the statewide network.

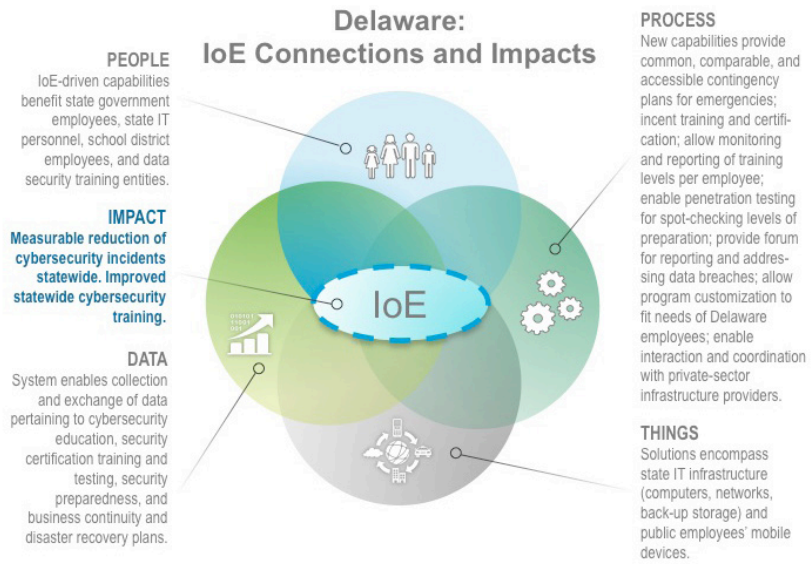
In terms of specific firewall and antivirus technology, Ms. Starkey indicates that the state of Delaware utilizes a combination of industry tools to ensure protection of the network. This is in addition to the specific user and IT specialist training that she sees as critical to combating threats and addressing vulnerabilities.

"Here is what happened. Our incident count increased dramatically. We were scratching our heads and thinking, 'We're trying to lower our exposure, and here we are getting more incidents than ever.' We concluded that those incidents were going on before the Education and Awareness – we just didn't know about them. Knowledge is powerful. You can't fix something until you know about it."

Elayne Starkey,
Chief Security Officer,
Delaware Department of Technology and Information

**Figure 1.** Delaware: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

Ms. Starkey admitted that, initially, measuring results of her work was difficult. "Not all of the benefits are easily quantifiable," she related, "but I will mention one in particular that caught us by surprise. We track the number of security incidents reported to our central service desk. Then, along comes our Education and Awareness program to increase people's knowledge and ensure they know who to contact. If they see something unusual or they've lost a laptop or a USB drive, they need to know what's expected of them in a case like that."

Ms. Starkey explained the initial numbers following implementation of her office's Education and Awareness activities: "Here is what happened. Our incident count increased dramatically. We were scratching our heads and thinking, 'We're trying to lower our exposure, and here we are getting more incidents than ever.' We concluded that those incidents were going on before the Education and Awareness – we just didn't know about them. Knowledge is powerful. You can't fix something until you know about it."

Ms. Starkey acknowledged that "on the surface, that might look like a negative metric," but as proof of increased awareness and reporting, her office interpreted the spike in incidents as a success. She indicated that as the Education and Awareness program has matured, the number of incidents has dropped measurably.

Due to the work of Ms. Starkey and her colleagues, Delaware is considered on the forefront of cybersecurity awareness, and has been recognized with a number of official awards and designations from the government and third-party organizations, including the Center for Digital Government and Disaster Recovery Institute International. Ms. Starkey was selected in 2012 as one of the 10 Most Influential People in Government Information Security by GovInfoSecurity.com.

## Lessons Learned / Next Steps

Ms. Starkey mentioned that one challenge of her work is securing cooperation from so many different state agencies and their employees. "We have to look for creative and interesting ways for them to get on board with the program, to incent them to pay attention to security, and to take the necessary steps to protect the data within their organization."

"We have to look for creative and interesting ways for them to get on board with the program, to incent them to pay attention to all this, and to take the necessary steps to protect the data within their organization."

Elayne Starkey,
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Ms. Starkey described the scorecard program as one such creative method of both vesting employees in learning and quantifiably measuring the success of the program. "That's been very helpful," she stated. "We've gone through three rounds now, on a biannual basis. We always put the previous scores at the top of the scorecard after the first round. That allows them to gauge how they are improving their overall security posture over the years. It also gives them a way to demonstrate to their management areas where they're not doing so well, and to help them lobby for the funding, or the resources, or the time, or whatever is needed to improve their score in the next round."

For each training event, Ms. Starkey tracks results and conducts analysis, noting possible areas of improvement. She said, "In the simulations that we go through, there's a list of lessons learned, and things we can tweak, and things we can do better. We document all those findings."

When asked what she considers the most frequently occurring area of improvement, Ms. Starkey replied, "This probably sounds generic, but it's communication. There's always a category for communication improvement. Participants often realize, 'I forgot to let so and so know,' or 'I forgot to loop this organization into the process.' We go back to the COOP plan and amend the checklist to make sure that they are not missed the next time. Because when you're in a crisis situation, much of your commonsense thinking goes out the window, and it is incredibly helpful to have a template and guidelines to follow."

 

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# IoE Capabilities Help Elon University Improve Safety and Security, Drive New Revenue, and Much More



**EXECUTIVE SUMMARY**

### Objective

- Have one network that connects all campus technologies

### Strategy

- Combine academic (data) and administrative (data) networks
- Implement unified communications system, which integrates several services into a single, centralized IP (Internet Protocol) network

### Solutions

- Wireless networks for students and faculty
- Improved data collection
- Door access technology
- Utilities management (HVAC)
- Phone video conferencing

### Impact

- Enhanced safety and security
- Improved ability to anticipate student and faculty needs due to collection of richer data
- New revenue streams
- More efficient energy usage

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Elon University

Founded in 1889, Elon University is an independent university with 6,000 students in Elon, North Carolina. The 620-acre campus houses nearly 80 buildings and offices, as well as a farm and land preserve.

Chris Fulkerson is assistant vice president for technology and CIO at Elon University. After starting as a technician in educational technology, he transitioned into directing the Learning Resources Center. Along with being a faculty member, Mr. Fulkerson has served as director of the library and director of professional development. Of his 32 years at Elon, Mr. Fulkerson has spent 15 in his current role of CIO.

## Objectives

Fifteen years ago, Elon University used a network that was piecemealed together with various switches, products from different vendors, and a separate telephone system. Because it was not a very robust system, it often failed. In addition, Elon used a costly, separate telephone network. Early efforts at integration were not sufficiently reliable or secure to meet the needs of students and faculty. Seeing the potential of having one network that connected all campus technology, Elon began laying plans for a unified communications system (UCS).

"We've had the vision of the Internet of Everything, so we've been working toward creating a network that supports everything."

Chris Fulkerson,
Assistant Vice President for Technology and CIO,
Elon University

Elon's network is already fairly unified in terms of emergency management and safety and security. "We've had the vision of the Internet of Everything, so we've been working toward creating a network that supports everything," Mr. Fulkerson explained. "Then we keep adding products as the budget becomes available. Because the campus is still growing, it has a lot of construction going on, which helps fund improvements. At this point, the university is gravitating away from stand-alone systems, and instead focusing on integrating new technologies into the UCS."

## Strategy

The first step that Elon University took more than 15 years ago was to combine the academic (data) and administrative (data) networks. "As we saw the potential of having one network that connected all technology, we knew we needed a more secure, more robust network – one that didn't fail," Mr. Fulkerson said. "In 2001–02, we started planning and building, and we have just continued to increase the capability of our network."

Shortly after Mr. Fulkerson became CIO, Elon implemented its unified communications system, which integrates several services – including voice over IP (VoIP) phones, wireless Internet, wireless points of sale, door access technology, utilities management, and video surveillance – into a single, centralized IP (Internet Protocol) network. Currently using a 10-gigabyte core, this network will likely be upgraded to a 20-gigabyte core in the near future.

As Elon's network expanded in breadth and functionality across campus, students and faculty were supportive. "It was interesting [to see] the shift in people's attitude towards this whole technology," Mr. Fulkerson recalled. "They've come to expect it, kind of like the lights – they don't care how it works; they just know it works." Initially,

Elon was pushing to become one of the top 100 wired campuses, and it made the list. When it moved into the top 50, however, students began pushing for wireless – they didn't want to be tied down by a cable. "So, soon we went after being one of the 100 most 'unwired' campuses, and we made the wireless list," Mr. Fulkerson said. Elon successfully put its finger on the pulse of new technology and student demand.

Funding for Elon's various technology systems originates from several sources within the university. The central IT budget provides funds for maintaining the network, covering the two core switches and building switches. Much of the architecture is funded through new construction: as Elon adds new buildings, this covers costs for not only the fiber, but also for the necessary redesign of the network's physical layout. "The security budget pays for security cameras, and sometimes helps fund door access, but usually construction pays for door access," Mr. Fulkerson explained. "When we first started the door access project, there was a special allotment that funded work on the existing buildings over a two-year period." Ongoing door access work in new buildings is funded through construction.

The central IT budget provides funds for maintaining the network, covering the two core switches and building switches. Much of the architecture is funded through new construction: as Elon adds new buildings, this covers costs for not only the fiber, but also for the necessary redesign of the network's physical layout.

While many departments have a stake in developing this technology and are utilizing the unified network, the university retains both governance and ownership. Mr. Fulkerson's office of IT has leadership over building the unified communications system.

## Solution

In terms of system architecture and design, Elon's integrated network supports several components of campus functionality related to Internet, phone, security, and building management. Some elements are hard-wired, such as door access technology and surveillance cameras, while others are wireless, such as data collection. All are supported via IP and a virtual server platform. With an Internet of Everything vision informing its upgrades, the university keeps adding products as budget becomes available. From a broad perspective, Elon is brainstorming how to do everything via IP – even appliances and lightbulbs – because this enhances its ability to gather data, control energy management, and handle replacement cycles.

### Wireless Networks for Students and Faculty

Elon started using wireless in 2000, when Mr. Fulkerson took over, which was early in the implementation of such technology nationwide. The project began with the library, and Mr. Fulkerson reports mixed reviews among faculty: "Some of my colleagues said, 'Wireless isn't ready for prime time yet.' Well, what we found out was the students were ready for wireless even though the technical people weren't necessarily ready. It was a big hit, and we had to add more wireless access points right away." Student usage definitively set in motion the expansion of this project.

This transition from wired to wireless also affects residence halls. At this point, "we're actually considering just going wireless in residence halls because that's what students are using," said Mr. Fulkerson. The current standard involves dropping a wire for every pillow, but Elon is thinking about cutting that back to one, or just putting it in the common areas. However, they're holding off going completely wireless in the rooms in order to accommodate future video-over-IP needs.

Elon takes wireless security seriously. “We are able to use virtual subnets and have very secure areas for our enterprise systems, our mission-critical systems, so they’re doubly protected,” Mr. Fulkerson explained. “They have a second firewall – a kind of a DMZ zone.” Even though the entire campus is firewalled, the logic in the UCS allows Elon to protect its critical systems with a second firewall.

## Data Collection

While student use of wireless technology justifies the expansion of such services, it also provides plenty of data that the IT department uses to determine what support to provide. “We only have 6,000 students, but we have over 14,000 unique wireless devices on campus every day connecting to our network,” Mr. Fulkerson said. “We get to see buying patterns of devices through some of that data.” Elon employs these analytics in planning support for devices and training technicians. “We see a lot of new devices come on campus; we can really track it after Christmas,” Mr. Fulkerson explained. “We’ve seen a huge upsurge of Apple products in the student population over the last five years, so we know we need to have more certified Apple engineers.” Tracking this data motivates tangible shifts in the technology department. In this case, the IT department began to cross-train technicians who were strictly Windows so they could become certified in Apple support.

“We’re able to track patterns of students, say, at lunchtime. Based on where they’re going, we can decide where we need to have more food and staff to handle the lunch rush.”

Chris Fulkerson,
Assistant Vice President for Technology and CIO,
Elon University

## Door Access Technology

Elon’s door access technology is another rich source of data. This initiative monitors not only movements of specific people, but also building capacity. The system returns data in two ways. First, it feeds back to the transaction system that tracks swipes, monitoring who goes into and out of a building. This data comes in handy for planning to meet student needs: “We’re able to track patterns of students, say, at lunchtime. Based on where they’re going, we can decide where we need to have more food and staff to handle the lunch rush,” noted Mr. Fulkerson. Elon is looking at how to gather all of the data that’s being collected at point of sale at any card swipe or door access.

Second, data from door access cards also has a tangible impact on security: “We know when people entered a building. “That [information] has come in handy in the past when we’ve done investigation. Using data from the cards, IP devices, and security cameras, we’ve been able to [help] solve crimes,” Mr. Fulkerson explained. This is yet another example of how the integrated UCS network supports campus safety and efficiency.

Elon is in the process of transitioning from card-swipe technology to contactless. “Beginning this summer,” said Mr. Fulkerson, “we’re going to change out everyone’s cards and a number of points of sale. Then we’ll work on the buildings over the next three to five years.” Moving to contactless cards will minimize the amount of maintenance involved and simplify the entry process for students and faculty.

Currently, Elon uses VoIP phone technology as part of its emergency broadcast system. This allows the university to alert students and faculty regarding any dangerous circumstances. “If there was a shooter on campus or a train derailment, we could put a message on the screen of the voice-over-IP phones,” Mr. Fulkerson explained. “We give an audio alert on all of our phones, but it’s also tied to a little crawl alert on our desktops. It’s also tied to our sirens. It’s also tied to our digital

signage, and we have speakers in buildings that are all IP-based." With these connections, Elon now has the capacity to reach everyone over the network.

## Utilities Management

Elon's IP network also supports its ability to manage campus utilities. Within the next three years, all buildings will be tied to that network. Mr. Fulkerson described his vision in this area: "We're working on centralizing and controlling all of our HVAC. We've got some older systems that aren't quite there, but all of our electric meters are IP-based. We get readings from those buildings and can track gas and electric meters."

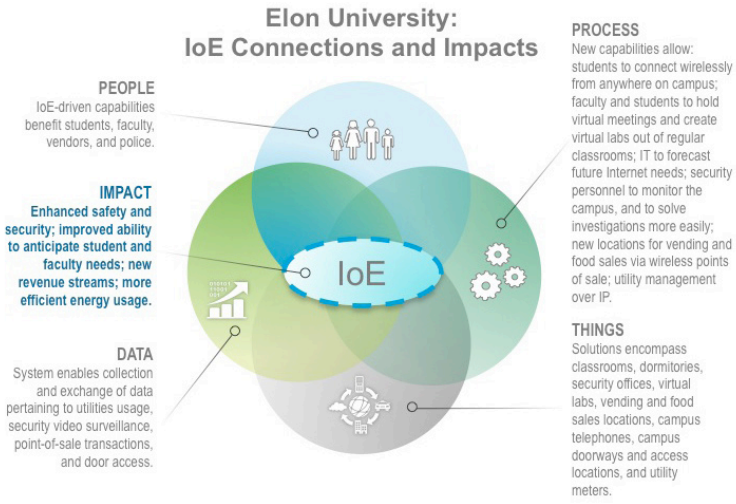
The utility companies installed the equipment, but the campus pushed them in order to be able to read meters and do power management in-house. "We worked out the bugs with protocol in the beginning, and now we have all of our meters hard-wired and IP-based," Mr. Fulkerson reported. "A lot of our new construction is LEED-certified, so we do a lot of power management, water management, fuel management in those buildings." Having a robust UCS network allows the university to gather data from these systems and manage them efficiently.

## Phone Video Conferencing

As part of the UCS plan, Elon replaced its former phone system with a VoIP network. Mr. Fulkerson reports that the new phone system is just as reliable as the old analog phones were, but they enable students and faculty to do so much more. "For example," Mr. Fulkerson explained, "we also have cameras on our IP phones. You can do video conferencing from your desk over the IP phones. Now, that's nice when it's raining and you don't want to walk all the way to the other side of campus or visit our remote law school campus in Greensboro, which is about 30 miles away." With the new system, students and teachers can video conference back and forth, and have meetings over the phone. "It's always better to see some facial expressions along with hearing the voice because there is so much communicated through body language," Mr. Fulkerson said.

With the new system, students and teachers can video conference back and forth, and have meetings over the phone. "It's always better to see some facial expressions along with hearing the voice because there is so much communicated through body language," Mr. Fulkerson said.

**Figure 1.** Elon University: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

### Safety and Security

One of the main benefits of Elon's unified communications system is enhanced safety and security. Placing video cameras in public places and hanging signs that warn of video surveillance has created a significant drop in theft. "As crime shows up in different locations on campus, we continue to install more and more cameras," Mr. Fulkerson explained. "That's a constant initiative for the campus police – they budget for more cameras every year, and we help them decide where to install the surveillance."

"Video surveillance has helped solve a lot of investigations – either by directly recording the crime or assisting the investigation. That's the safety and security."

Chris Fulkerson,
Assistant Vice President for Technology and CIO,
Elon University

Not only does video surveillance deter crime, but it also helps increase the percentage of solved cases. "Around graduation one year," Mr. Fulkerson said, "the police were watching the monitors because a lot of pranks happen. A student picked up a rocking chair from one building and carried it across campus to his residence hall, and the police were able to track it from camera to camera to camera. When they sent a patrol car to the residence hall, they found the student sitting in the rocking chair. They asked, 'Where did you get the rocking chair?' and the guy responded, 'Oh, I found it here.' 'Really? Why don't you come back to the station with us,' the police said, and showed him the footage of him carrying the rocking chair. He was like, 'Okay, you got me.'" This shows how having video surveillance can completely negate any argument – in many instances, more cameras means more cases solved.

Sometimes, when the cameras and IP devices don't pick up the actual violation or crime, they can help police confidently narrow down who was near the crime scene. Mr. Fulkerson summarizes: "Video surveillance has helped solve a lot of investigations – either by directly recording the crime or assisting the investigation. That's the safety and security."

Mr. Fulkerson also described the new subnet network's reliability, pointing out that several years ago, when the last denial-of-service attack virus negatively affected Windows machines, Elon never experienced a crash. "Where other schools went down for three or four days, Elon never had a problem," Mr. Fulkerson stated. "We were able to suppress it on our network, handle the load, and continue to function. We've had a pretty robust network for a while." This sort of reliability was a huge change from the piecemeal system Elon had used previously, and it showed that the system could be expanded.

### Wireless and One-Card Sales

UCS has significant positive impact on revenue streams at Elon. "For example, at football games, the entire stadium is wireless," Mr. Fulkerson explained, "so when we have vendors come in, we get some revenue from that. They have a card-swipe device that's wireless, so it goes to our transaction system and we get a commission off of that." Elon has simplified campus sales by introducing the one-card system. Mr. Fulkerson explained: "We have one card accepted all over the county. There are restaurants, drug stores, and ice cream and yogurt stores that all take our one card." Vendors who do business on campus have to accept the university's one card. For consistency, all vending machines are also connected, so students can use the one-card system.

In addition, UCS enables Elon to create new places for vending and registration using wireless points of sale. “The bookstore now has a trailer that goes to the stadium, and they sell lots of athletic gear at a wireless point of sale. When a conference on campus sells books, T-shirts, or products, that’s all done using wireless. We even use wireless registration points for these conferences,” Mr. Fulkerson said. “On admissions day, students come in, register, check in, and that’s all done via wireless network.” This network gives Elon the flexibility to do business in different ways – instead of being tied to a wired port, sales and registration can occur just about anywhere on campus.

Along with upgrading door access technology from swipe to contactless over the next three to five years, Elon has many smart campus projects in progress, including adjusting bandwidths to accommodate video over IP and centralizing control of HVAC over IP.

## Lessons Learned / Next Steps

### Expansion and Expectations

One of the biggest challenges that Mr. Fulkerson’s department faces is being a few steps ahead of the game. He describes how his group tries to anticipate student and campus needs by looking at the institutional strategic plan. “We try to be three years ahead as far as the technology is concerned, so that when people start saying, ‘I want to do this,’ we’re ready for them,” said Mr. Fulkerson.

One challenge Elon faces is matching its technological expansion realistically with its rate of growth. “We make it look so easy in the technology area that students think it’s just a matter of ‘plug and play,’ but they don’t realize the infrastructure that comes in to make it that simple,” Mr. Fulkerson said. At times, the challenge of this growth brings Mr. Fulkerson face to face with unrealistic expectations. “For example, there was an incident on a part of the campus that didn’t have security cameras,” he explained. “It was big enough that the trustees were aware of it, and they pushed for 100 more cameras. Well, putting in 100 more cameras is not something you do overnight, and they didn’t understand why.” He had to set realistic expectations for the trustees about how long it would take to obtain 100 cameras, and to complete the wiring, power, mounting, and provisioning. He also let them know that even back-end storage would have to increase.

However, some challenges associated with rapid growth are good. As Elon builds more buildings, it has outsourced more, and it often runs vendors to capacity. “It’s a problem of our success,” Mr. Fulkerson said. With money available, the challenge has been to allocate sufficient resources and time to finding and managing contractors and provisioning cameras, door swipes, and network switches to keep up with all the construction and expansion.

Along with upgrading door access technology from swipe to contactless over the next three to five years, Elon has many smart campus projects in progress, including adjusting bandwidths to accommodate video over IP and centralizing control of HVAC over IP.

Elon’s fire alarms are on the network, and the university plans to tie those into the security cameras. “If an alarm goes off, it will be highlighted in safety and security so they can say, ‘Oh, there are flames,’ or, ‘It’s smoke from a garbage can.’ Then one of our officers can deal with it, rather than having to call the fire department.” When problems can be identified and resolved on campus, both efficiency and safety are enhanced.

## Next Step: Virtual Lab Classrooms

Meeting expectations as the university expands is one of the reasons Mr. Fulkerson's team has been researching virtual computer labs to supplement fixed labs. This research anticipates the possibility of having a computer lab anywhere, rather than in a fixed location; it would involve creating virtual desktops and virtual applications. "Students are bringing two or three mobile devices with them – a phone, tablet, a laptop," he explained. "Why do we need to have only fixed computer labs? This year is the first time the math department ran out of computer labs for their classes and needed more labs. Well, instead of building more labs, we said, 'Let's do virtual labs.'"

"Realize that those innovative things will be mainstream faster than you think they will be, and you have to have the infrastructure in place."

Chris Fulkerson,
Assistant Vice President for Technology and CIO,
Elon University

The concept of virtual labs allows any classroom to become a lab. Students can bring any kind of device that lets them log in and use the software on a server virtually. They can either have a virtual desktop, or just use the app virtually. "We've gotten good feedback from the project. We know it's going to explode as we look at more flexible learning spaces," said Mr. Fulkerson. As virtual labs become more accessible, Elon's IT department will have to figure out how to supply more power outlets, or increase battery life on devices. "If our network provider could do something about wireless power, I'd be grateful," Mr. Fulkerson joked.

## Next Step: IP Everything

"Video over IP is our next phase over the network," Mr. Fulkerson said. "So we are working to make bandwidth more robust – going from 10 gigabytes to 20 gigabytes on the core." Right now, the university has a coaxial cable system that's still in the ground, but they're planning to phase that out. According to Mr. Fulkerson, rather than upgrade the nearly 30-year-old coaxial cable that has been cut and patched hundreds of times, Elon is looking at using the fiber network to get to the buildings, and then breaking out to coax into the rooms.

From a broad perspective, Elon is brainstorming how to do everything via IP – even appliances and lightbulbs – because this would enhance its ability to gather data, control energy management, and handle replacement cycles better. Although some systems are aging, all of Elon's electric meters are IP-based, enabling the university to track meter data. Within the next three years, Mr. Fulkerson predicts that all campus buildings will have IP-based, centralized HVAC control. "It's just the inevitable evolution of networking for us," Mr. Fulkerson concluded.

## Lessons Learned

If Mr. Fulkerson were to offer advice for other schools implementing these projects, he said he would emphasize the need to plan for possibilities even though the technology may not be there yet. "Try imagining what could happen or what you would like to happen," he suggested, "so that when the technology comes out, you can incorporate it in your network." Without this sort of future focus, schools can find their capabilities outpaced by campus needs – they struggle to handle the number of devices on the network. Mr. Fulkerson recommends paying attention to the literature, student patterns, and faculty innovation. Instead of waiting for demand, "realize that those innovative things will be mainstream faster than you think they will be, and you have to have the infrastructure in place," he counseled.

Schools are particularly subject to losing credibility if they fall behind technologically because playing catch-up rarely meets student needs. Instead of greeting new ideas with a timeframe of years to implementation, schools need to have already done the legwork. “It’s much more credible,” Mr. Fulkerson stated, “to be forward-thinking, so that when great ideas and new technology show up, you can say, ‘We can handle that.’”

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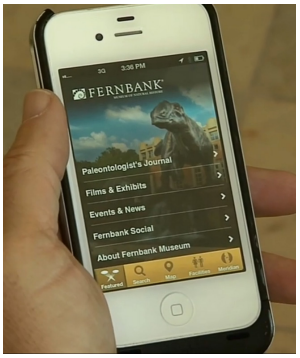
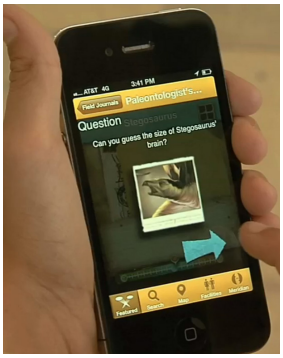
# IoE-Driven Mobile App Improves Visitor Experience for Fernbank Museum of Natural History




**EXECUTIVE SUMMARY**

### Objectives

- Make museum a more dynamic educational and social location, while improving overall experience of museum visitors
- Create engaging technological interface between museum and its guests

### Strategy

- Take cross-functional, interdisciplinary approach to developing Wi-Fi network and mobile application

### Solution

- Interactive, museum-branded mobile application delivers targeted content to museum guests through a high-density web of Wi-Fi connectivity
- App also provides museum officials with useful data that guides distribution of customer-segmented promotional content

### Impact

- Density of Wi-Fi availability throughout museum enables additional exhibit content
- Has allowed museum to easily deploy hardware behind the scenes
- Engaging guests via their personal devices encourages a more in-depth learning experience

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Fernbank Museum of Natural History

Fernbank Museum of Natural History, a private nonprofit located in Atlanta, Georgia, opened its doors to the public in 1992 with a mission to inspire life-long learning of natural history through immersive programming and unmatched experiences to encourage a greater appreciation of our planet and its inhabitants. In 2013, Fernbank teamed its ecological and prehistoric exhibits with cutting-edge technology to make the museum experience more interesting and relevant to a technologically savvy public.

With the aid of corporate sponsors and private donations, Fernbank created an interactive museum-branded mobile application. The app delivers targeted content to museum guests through a high-density web of Wi-Fi connectivity. In addition to guiding and educating the user, the app provides museum officials with useful data that guides the distribution of customer-segmented promotional content.

The goal for the app, says, Ms. Warner, was to “really connect with the guests the moment they set foot on the property.”

Jennifer Grant Warner is the chief programming officer of Fernbank Museum of Natural History. Serving as project manager on the museum’s recent technological upgrade, Ms. Warner worked closely with Chief Technology Officer Dana Harvey and the museum’s educational team, as well as with corporate partners, to create an engaging technological interface between the museum and its guests.

Prior to her association with the Fernbank museum, Ms. Warner worked as a manager in community development for the Metro Atlanta Chamber of Commerce, and in governmental affairs for the Kentucky Chamber of Commerce.

## Objectives

Desiring to expand its attractiveness as an educational and social location, in 2012 Fernbank sought to upgrade its technical infrastructure by implementing free, high-density Wi-Fi capability throughout the museum. Teaming with outside partners, Fernbank explored different Wi-Fi options. Fernbank now has installed a complete Wi-Fi network that provides free Wi-Fi access throughout the museum and in key outdoor spaces. Accessible to museum patrons and staff, the network has been well received by both groups. Patrons enjoy mobile Internet access, while staff (particularly the technology office) like being able to deploy new technology and exhibit capabilities that the wireless network makes possible.

Working with corporate partners, Fernbank also decided to expand the project beyond the Wi-Fi network to include an interactive mobile application that provides a custom-built museum guide for visitors as they move throughout the exhibits. The app is downloadable via the museum’s website or via the iTunes and Google Play stores. It includes targeted educational content, games, a museum map with directional service, pictures, and exhibit information. It also has the capability to provide event notifications, vendor locations, and discount coupons. The goal for the app, says, Ms. Warner, was to “really connect with the guests the moment they set foot on the property.”

## Strategy

"The team [took] a cross-functional, interdisciplinary approach," Ms Warner explained. "Our chief technology officer was involved, along with members of his team, but also our education team, because we came up with ways to utilize the technology from an educational content delivery perspective, as well as with marketing, because this was now a new way for us to connect with our guests before they step into the building. It really becomes another branding tool for us as well."

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Jennifer Grant Warner,
Chief Programming Officer,
Fernbank Museum of Natural History

One of the first questions Ms. Warner addressed during the planning phase of the project was how to provide the mobile hardware for the application. She and her team weighed the option of renting devices to visitors, but eventually settled on a "bring-your-own device" approach. "From an operational standpoint, we didn't like getting into the business of checking out devices and having to keep someone's driver's license," she said. The decision to rely on visitor-supplied hardware was also supported by research from the American Alliance of Museums, which predicted that a sufficiently high percentage of attendees come equipped with smartphones. According to Ms. Warner, this has proved to be the right decision.

Ms. Warner indicated that the museum originally chose a non-branded application that provided general information about the exhibits, but it was dissatisfied with the results. "One of the things we know was not having a branded app the first time really affected us. People had a harder time finding it," she says.

The app was replaced with a customized and branded version, the Fernbank Museum Application, available for free download at the museum and through other application vendors. The new app includes the museum's logo and customized content for the displays, and is far more interactive. It allows for easy modification, including updated promotions as exhibits and IMAX features change.

One unforeseen aspect being addressed as the application is further developed is what Ms. Warner describes as the "heads-down" impact of integrating a mobile application with the traditional museum experience. Creating an app that both expands learning and draws the attention of patrons to the exhibit before them is the challenge. "It's finding that balance of in-the-device, but also within the context of everything else going on around them. We can't have them too much into 'zombie mode,'" she said.

## Solution

Ms. Warner began with a modest goal for what became the technological transformation at Fernbank Museum: free public Wi-Fi. "It's what people are expecting when they come as guests," she explained, "but also we are a private event facility. That's an important business unit for us here at the museum. A lot of those clients were expecting that, and it was hurting us if we didn't have it."

As she explored the option of expanding the project beyond a network of limited access points, Ms. Warner consulted with various museum board members about how Fernbank could leverage a Wi-Fi network to get corporate donors excited about the efforts of the museum.

 

After attracting the attention of multiple technology companies, the scope of the project grew rapidly. In addition to museumwide Wi-Fi, Ms. Warner began researching development of an interactive app to create an avenue of communication between the museum and its guests.

To establish the high density Wi-Fi network required for effective location-based technology, the museum installed 72 Wi-Fi access points throughout the 150,000 square feet of museum, as well as in key outdoor locations. Hardware installations were completed after-hours to avoid disturbing daytime traffic, and access points in public areas were designed and painted to blend in naturally with background settings throughout the museum.

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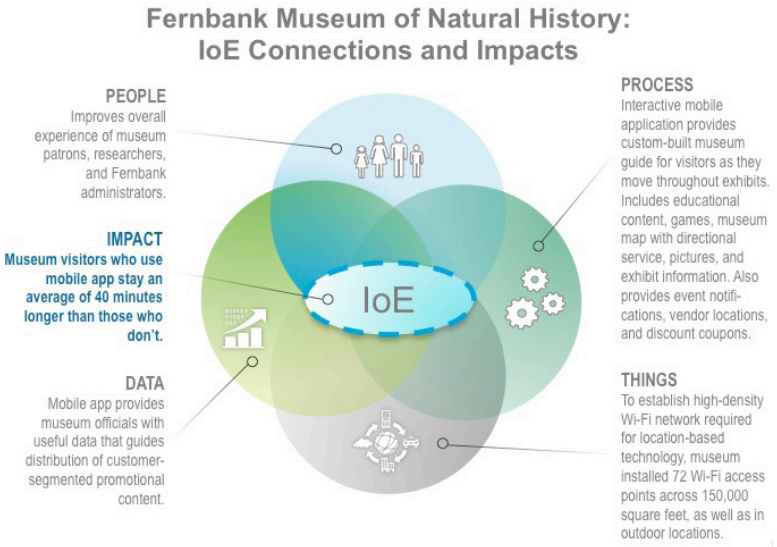
In concert with deploying the Wi-Fi network, Fernbank also worked on developing the Fernbank Museum App. Because Fernbank is an ecologically friendly establishment that promotes green practices, Ms. Warner says that reducing consumer dependence on paper maps was a top priority. However, she recounts that throughout the design of the project, she and her team examined how best to develop the software beyond a simple mapping application into a fun and engaging experience for guests. With this perspective, the Fernbank Museum App matured into both a "virtual concierge" for guests and a messaging and data platform for the museum.

Ms. Warner described how one app activity, the Paleontology Journal, is particularly well-designed to hold the interest of visitors. "It gives guests special experiences and special content that they can't find anywhere else on our web or even in the displays that you see on the floor," she explained. "It's exclusive to the device. It's a special tour that takes you through different parts of the museum, and ties them together with a thread that you wouldn't see otherwise. It has some games built in, some multiple-choice quizzes [and] an exclusive video. It's a way for us to promote what's going on in the building."

**Figure 1.** Fernbank Museum of Natural History: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

Ms. Warner points to a number of benefits that the new Wi-Fi network provides. First, she indicates that the density of Wi-Fi availability throughout the museum enables additional content in the exhibits. “We’ve added some kiosks in one of our hands-on exhibitions, and we are drawing the data through the Wi-Fi network,” she said. “That’s really been helpful for us in terms of thinking about how we can do our exhibitions going forward. Not having to hardwire everything is great.”

Additionally, Ms. Warner indicated that the Wi-Fi network has allowed the museum to easily deploy hardware behind the scenes (in staff work rooms or meeting rooms, for instance). Warner further admits that wide Wi-Fi availability is a necessity in today’s connected world, both as a convenience to guests who expect it, and as a crucial avenue for museum administration in planning staff coordination, event management, education, and advertising.

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Jennifer Grant Warner,
Chief Programming Officer,
Fernbank Museum of Natural History

Ms. Warner cites a number of benefits from the app development as well. For example, the app allows the museum to track location data of its visitors. By analyzing guests’ progress through the app’s journal function, administration can identify both dwell times at specific exhibits or locations, as well as overall time spent in the museum.

Ms. Warner describes how engaging guests via their personal devices encourages a more in-depth learning experience, and results in longer visits. The app creates a dialogue with guests from the moment they arrive, guiding them through the museum and presenting educational information in a way that encourages in-depth exploration of the museum.

Effective analysis of visitor data is also a valuable tool for management. Ms. Warner says that data analysis from app users provides a heat map of visitor patterns, revealing popular attractions as well as those needing more attention, “It can help us with our logistics planning and seeing inside, for instance, our children’s exhibition,” Ms. Warner explained. “We keep staff up there that serve as facilitators, because it’s a very highly interactive hands-on exhibition, so we really have to monitor the usage and the traffic. I think, anecdotally, I know what’s going on with the crowds in there, but now this gives me even more evidence, and actual data points, to see that ebb and flow throughout the day of people in that exhibition.”

Ms. Warner also indicated that the museum plans to use the app to push out promotions for upcoming attractions, as well as notifications when an IMAX feature or other event is about to begin. This would allow targeted communication with patrons in the museum, as well as broader communication with those who are outside the museum but who have downloaded the app. For outside visitors, the app could be used to highlight an upcoming exhibit and to encourage repeat visits. For those already in the museum, the app could send coupons to visitors’ mobile devices to drive traffic to the gift shop or café when business is slow.

Ms. Warner sees the promotional potential of the free branded app as a valuable tool for the museum. With the Fernbank icon appearing on each user’s mobile device, it would increase the visibility of the museum upon downloading, and provide an instant avenue to museum information for users.

 

## Lessons Learned / Next Steps

Ms. Warner considers the replacement of the original application with a branded app as crucial to the success of the project. Other improvements in the Fernbank Museum app include an increased ability to collect visitor data, along with the marketing advantages of icon visibility.

Ms. Warner considers the replacement of the original application with a branded app as crucial to the success of the project, and downloads increased with the new version.

Ms. Warner says the full capacity of the project to impact visitor behavior and encourage attendance and engagement is still being developed. Future plans include the creation and delivery of new educational and promotional content for the app, an essential step to keep visitors interested in repeat attendance. Ms. Warner advises, "If you are working through an app, you've got to keep that fresh and interesting or people aren't going to use it."

Ms. Warner is enthusiastic about the future potential of the museum's new upgrade, but advises prudence in choosing areas of development. "I still think we're in the early stages, but there's a lot more [to come], and it's so robust," she explained. "You can think about all the uses of how it could be done, but as a nonprofit, you really have to prioritize and say, 'Okay, what's going to make the most sense for our situation?' It's important to find the right balance in terms of where to use the technology, and not to just use it for technology's sake."

## More Information

For more information, please visit http://www.fernbankmuseum.org and http://www.fernbankmuseum.org/visit-fernbank/fernbank-museum-app/

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# IoE-Driven Capabilities Help George Brown College To Simplify Building Management, Cut Costs, and More


## EXECUTIVE SUMMARY

### Objective

- Rethink teaching methodologies and the traditional classroom setting
- Install a state-of-the-art, advanced high-speed network available anywhere, anytime on campus
- Incorporate multimedia technology within the educational experience to assist both on-campus and distance education
- Utilize fully integrated smart building technology on a single, easily controlled platform interface
- Establish future-proof network capacity and equipment specifications

### Strategy

- Employ open network platform to provide both Wi-Fi capability and hard-wired access throughout the campus
- Enable a wide variety of audiovisual experiences across learning settings

### Solutions

- Single-dashboard control of all building control and automation systems, security cameras, audiovisual controls, environmental controls, educational tools and activities, and communications with other campuses
- Adaptable multimedia learning lab classrooms
- Unified communications and telephony

### Impact

- Easier communication among campuses, simplified building management and control, reduced resource consumption, and decreased operational costs

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

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The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

 

## About George Brown College

George Brown College (GBC) is a public post-secondary educational institution founded in 1966. It operates three full campuses in the Toronto, Ontario, metropolitan area, including the new Waterfront campus, whose phase-one Centre for Health Sciences building opened in September 2012. The new campus is located on the Waterfront Toronto East Bayfront, a heritage industrial redevelopment district.

The Centre for Health Sciences building has architectural, urban planning, and technological importance in Canada and worldwide. The Intelligent Design technology solution includes 25 multimedia learning lab class environments, more than 50 audiovisual areas, an IP-enabled mechanical and lighting system, and a user-friendly dashboard facility control system, all layered upon a single, high-speed converged network.

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Terry Comeau is executive director of Waterfront development at George Brown College. Prior to joining GBC, she directed architecture and planning for AECOM in the Middle East, and was the founding partner/senior vice president of the HOK Canada consulting architecture and interiors practice. Ms. Comeau has an extensive architectural design background, with broad project experience in healthcare, hospitality and resorts, media facilities, and mixed-use residential developments. She directed development (including design and construction) of the Centre for Health Sciences building, which was executed by EllisDon Construction.

Michael Wolf is senior ICT project manager at EllisDon Construction, where he specializes in communication cabling design and construction, network system design, security systems, and building systems integration. Mr. Wolf served as master integrator on the GBC Waterfront project, coordinating the Intelligent Building network and building integration technology design and implementation.

## Objectives

Ms. Comeau and Mr. Wolf set several technology goals that guided design and implementation:

- Rethink teaching methodologies and the traditional classroom setting
- Install a state-of-the-art, advanced high-speed network available anywhere, anytime on campus
- Incorporate multimedia technology within the educational experience to assist both on-campus and distance education
- Utilize fully integrated smart building technology on a single, easily controlled platform interface
- Establish future-proof network capacity and equipment specifications

Waterfront Campus Phase One has achieved these goals by providing progressive learning environments such as the new multimedia classroom experience, as well as increased connectivity, efficiency, and cost savings.

 

## Strategy

The technology concept for the Centre for Health Sciences building included a "plug and play, anywhere, anytime" mandate that would support the modern student's mobile learning philosophy. However, given the bandwidth and speed required to support extensive video streaming, an open network platform was designed to provide both Wi-Fi capability and hard-wired access throughout the campus. "We had to provide this level of access because we anticipated having to accommodate increasingly high peak video streaming on the bandwidth that we had," Ms. Comeau explained. "If you are in a teaching setting, for example, we wanted to ensure that everybody would have access to high definition, speed, and clarity of content in terms of viewing video from anywhere in the room either on the projection system, individual laptops, and/or smartphone simultaneously. So our baseline is wireless, but we also have hard-wired connection points available within short physical proximity." Both wired and wireless technology support GBC in delivering high-quality applied education programming for its students.

"The design intent was to address and captivate a new, modern student, one who is social media-savvy and living on a smartphone, but is learning with an applied profession [requiring hands-on learning]. We researched technology that fit the need at that moment in time. That really impacted the final solution that we came up with."

Terry Comeau,
Executive Director of
Waterfront Development,
George Brown College

Enabling a wide variety of audiovisual experience across learning settings was a core driver of the network solution chosen. Ms. Comeau sought to "accommodate the rapid transition to online learning, distance learning, live and recorded video projection, and the use of video in the classroom and beyond." GBC's fully wired and wireless building supports advanced AV technology for class learning of all kinds, demonstrations, and high-fidelity simulation environments. The essentially ubiquitous connectivity "speaks to our core competency as an educational institution," Ms. Comeau explained. "We now have infinite educational settings toward which we can drive content, including our adjacent outdoor park, the Waterfront promenade, and anywhere within the building itself."

The design of GBC's network design was heavily influenced by an understanding that it needed to accommodate the technologies favored by students. "The design intent was to address and captivate a new, modern student," said Ms. Comeau, "one who is social media-savvy and living on a smartphone, but is learning within an applied profession [requiring hands-on learning]. We researched technology that fit the need at that moment in time. That really impacted the final solution that we came up with."

GBC's relatively limited educational budget guided many decisions, including the choice of network technology. Generally, it's challenging to obtain scarce government funds to upgrade technology capacity, so technology elements needed to be included within the one-time funded construction. "At the outset of the project, one of our key drivers was to create a highly intelligent building within the funding parameters of the Canadian college system," said Ms. Comeau. She focused on future-proofing the network as far as possible in order to achieve at least five years of sustained network performance and accommodate student growth in that period without having to go back and rebuild the system.

George Brown College receives financial support from a number of sources, including student tuition and fees, the Canadian Ministry of Education, the Ontario Ministry of Education and Training, corporate and research grants, fundraising, and donations. The institution is governed by the Ontario provincial Ministry of Training,

 

Colleges and Universities and is funded by the Ontario Ministry of Finance. The Board of Governors is the legal body governing the college. GBC conducts its business largely through the Academic and Student Affairs Committee, Finance and Property Committee, and Audit and Executive committees.

At capacity, the George Brown College Waterfront Campus will serve 3,500 full-time students plus part-time and continuing-education students. The Waterfront Campus project represents an approximate $175 million CAD investment. The College received $30 million from Canada's Federal Knowledge Infrastructure Program and an additional $61.5 million from the Province of Ontario. Additional support for the project was provided through college reserves and a private sector fundraising campaign.

The network was budgeted for and integrated into the technical layout plans of every area of the building from the beginning, far in advance of construction.

## Solution

### Network Platform

The GBC team put a great deal of research and planning into developing the network in terms of both capacity and connectivity. Highlights of the network system include:

- 10G backbone network connectivity
- Fiber backbone: 2X24 strand multimode to each closet (dual runs with pathway diversity)
- Cat6 cabling throughout
- Edge switches: 3750X PoE enhanced for all closets
- Dual 6509 core switches for full redundancy
- Separate edge switches for security system (access and CCTV)
- Unique VLANs for all vendor systems

The network was budgeted for and integrated into the technical layout plans of every area of the building from the beginning, far in advance of construction. Technology design determines many essential elements of construction sequencing, explained Ms. Comeau, and it's expensive to retrofit systems later. Conduits (and the structured cabling they hold) were laid before concrete floor slabs were poured; communication facilities were ready before everything else; and vertical fiber-optic duct banks, horizontal conduit runs, system sizing, correct fiber-to-copper, and fiber-to-fiber connectivity were also factored into the design. "The size of your future technology network is only as fast as the pipeline within, and only as fast as the slowest connectivity between your building and the other buildings of the college campus, the main computer hub of the college, and the main security hub of the college," Ms. Comeau explained.

To enhance both educational and environmental efficiency, GBC integrated all building technology systems onto a single platform. "We went with a system configuration that promoted adaptability, flexibility, and as much speed as we could afford on an open systems architecture platform," said Ms. Comeau. To accomplish this, the project team proceeded with a design/build network construction process

 

that included a remote, lab-built and tested switch platform utilizing an open network topology for the layering of subsequent technology.

"During construction," said Ms. Comeau, "our biggest concern was the early delivery of the network-capacity modeling, design of the network, construction and testing of the network, and ensuring that the network was live. That had to be accomplished as early as possible in order to facilitate the installation and testing of all environmental, audiovisual, and network-dependent equipment."

Meeting the goal of integrating the full system on a single platform proved challenging. Switching gear and equipment could not be moved into the building due to ongoing heavy construction, dust, vibration, and security concerns. In order to answer these concerns, EllisDon partnered with a telecommunications provider to build and fully test the network remotely, under laboratory conditions, so that the installation would proceed flawlessly. The network was implemented ahead of schedule as a result of the team's collaborative efforts. In addition, mission-critical building HVAC equipment had to be installed, operational, and fully commissioned before systemwide testing and integration could even commence.

"This solution was cost effective, and the emerging technology helped future-proof our operation. Most important, the configuration supported our plug-and-play, anywhere, anytime operations."

Terry Comeau,
Executive Director of
Waterfront Development,
George Brown College

The project also triggered upgrades in the network pipeline to and from the other GBC campuses and main computer hub to ensure Waterfront Campus network design speeds. "It's not just the building itself," Ms. Comeau explained. "The new building that you're creating is part of a much bigger pipeline system for the institution as a whole." GBC needed to build server rooms and upgrade facilities to create a level playing field across existing networks and portals.

## Smart City Connectivity

In addition to the college's own high-speed Internet service, advanced ICT infrastructure will be provided throughout the East Bayfront District by master developer Waterfront Toronto (WT). WT will provide a fiber-optic cable foundation that is expected to go live on the campus in the near future. "The additional connection for the Waterfront will facilitate connectivity to our residence at the Pan Am Village site [a neighboring campus], which is great. We will have a high-speed, low-cost, high-bandwidth information highway that facilitates our educational drivers for high-speed video, SIP trunking, online learning, and distance learning."

## Audiovisual Technology

The campus's integrated video technology is enabled by the installation of Canada's first 64x64 broadcast matrix AV switch. Lectures, lab procedures, training exercises, research and development work, and other learning activities can be recorded and then shared online virtually anywhere – a process that can easily be controlled by the instructor. Ms. Comeau noted that the matrix switch was chosen over a number of smaller, slower switches, which would have limited connectivity. "This solution was cost effective, and the emerging technology helped future-proof our operation. Most important, the configuration supported our plug-and-play, anywhere, anytime operations."

Additionally, with over 90 percent of the student body traveling significant distances to the campus, an emphasis on distance learning helps GBC meet local student

 

needs. The school also has teaching environments in India and China, and supports courses for thousands of online students coming from numerous countries. "Our concept," said Ms. Comeau, "was basically to be able to transmit high-speed, high-definition video anywhere on the campus or remotely online to facilitate distance learning. We are now able to record applied-learning vignettes and port them around the world." Much of this video-based learning comes in the form of demonstration, so students can practice and learn hands-on healthcare techniques even when they are far from campus.

## Redesigned Classrooms

According to Ms. Comeau, research has clearly demonstrated that today's students need a new learning process, and that more than 70 percent of learning happens outside the lecture process. GBC's goal was to address these social media-savvy, communicator/collaborator students by engaging them in an active learning process. This meant creating supportive group work environments, facilitating the teacher's emerging role as mentor/coach (as opposed to lecturer), and aligning the student and teacher in the learning process.

"Our concept was basically to be able to transmit high-speed, high-definition video anywhere on the campus or remotely online to facilitate distance learning."

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Executive Director of
Waterfront Development,
George Brown College

"It's all about video," Ms. Comeau explained. "It's all about high-speed/high-definition bandwidth for video, and how GBC could really facilitate the transfer of that technology throughout our system." Although video allows learning to take place anywhere, anytime, the classroom and professor still have important, but different, roles to play. GBC wanted to reimagine the classroom space to get the best results from media-based education by providing professors with tools that enable more active engagement with students. "We wanted to facilitate professors' movement: walking around the classroom, enabling technology from anywhere in the room, and facilitating interaction with the students. With this teaching scenario, students couldn't sit at the back of the room on Facebook during the lecture, as it was so much more interactive," Ms. Comeau explained.

To research emerging technology and classroom environments conducive to new ideas in learning, Ms. Comeau and her team toured simulation centers and learning studio/learning lab environments throughout North America. "We did considerable research into the setup of a learning laboratory environment or learning studio environment as an important progression beyond the old style, lecture environment," she noted.

Professors and students were then invited to test prototypes of various furniture types and classroom layouts before GBC committed to a particular classroom solution. "From a simulation, technology, and furniture perspective, we looked at how companies globally were designing furniture to integrate with advanced technology programming. We ordered products, put them into a prototype setting, and had professors work with the learning lab settings," Ms. Comeau recalled. She indicated that testing and research were conducted for 18 months before any final orders were placed.

After the trials, Ms. Comeau opted for class and study-area seating and tables that achieved both technology and learning goals, such as mobile chairs with oversized tablets and places for backpacks and beverages. The table surfaces chosen are

 

robust, movable, and sized to accommodate laptops and shaped to support study groups. The general impression, she describes, is "more comfortable, more living-room-like than rigid classroom furniture." This feel contributes to the connected environment of the school, and facilitates an inviting and inclusive atmosphere.

As for the classroom setup, adaptable multimedia learning lab classrooms replaced old-style lecture halls. Audiovisual technology – the Wi-Fi network platform, multi-media projectors and supporting screens, mobile classroom furniture, and a mobile pedestal/lectern – was the key to ensuring that these new environments performed, allowing the professor to attain a mobile presence in the classroom, and facilitating a more connected and engaged student population.

"For faculty and staff, to achieve this level of environmental control as building users was one of the key achievements of the project. Our dean of health services couldn't stop demonstrating the system to visitors. Ultimately, I feel it is at the individual user level that environmental controls become a potent force for energy conservation."

Terry Comeau,
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Waterfront Development,
George Brown College

Waterfront Campus also includes special technology-based simulation practice labs (with a simulation operating theater) and equipment used to train future healthcare workers in applied techniques. Many of these centers employ high-fidelity mannequins programmed to deliver symptoms of disease, and respond in a prescribed way to student healthcare workers as they provide care to the "patient".

## Telephony/Voice

GBC uses a PoE enhanced switch for unified communications and telephony. In addition to voice and emergency notification capabilities, the phones allow faculty and staff to control workplace conditions in the spaces they often occupy – such as temperature, lighting, and blinds – right from their desks. According to Mr. Wolf, this phone system "was so important for the overall technical solution. The value proposition … was the PoE enhancement, [which holds] a much higher power draw per port."

Ms. Comeau added: "For faculty and staff, to achieve this level of environmental control as building users was one of the key achievements of the project. Our dean of health services couldn't stop demonstrating the system to visitors. Ultimately, I feel it is at the individual user level that environmental controls become a potent force for energy conservation." It is also possible to instill energy conservation competition among groups.

## Building Management

Intelligent Building integration was another priority. GBC's Waterfront campus features single-dashboard control of all building control and automation systems, security cameras, audiovisual controls, environmental controls, educational tools and activities, and communications with other campuses. A network of sensors digitally monitors the systems, and in the cases of systems like lighting and HVAC, alternates between "vacant" and "occupancy" modes depending on activity level, which door-access key cards control.

From a professor's perspective, said Ms. Comeau, the experience is that "you swipe your card; you walk in to the classroom. The lights go on for you. Energy (HVAC) goes from energy conservation mode to classroom-occupied mode – so that would be from, for example, 65 to 68 to 70 degrees, depending on preference. Blinds will go up or down, depending on what your preference is. The audiovisual system will be enabled," she said. And class is ready to begin.

 

Building operations and security staff view and manage settings in real time as well as remotely. A notification system composed of graduated alarms and triggers for both proactive building management as well as occupancy management alerts personnel to maintenance issues, such as when a light needs to be changed. The remote aspect of the system is important: "Plug-and-play access anywhere, anytime was a baseline operational requirement for us," said Ms. Comeau. "Let's say you're home on the weekend and the audiovisual computer room temperature starts to rise. You will get a notification on your iPad that there's an alarm going off." The staff person would then be able to take quick action.

The control software and interface utilize an open architecture, central management software system that integrates equipment and event signals to the highly intuitive and actionable dashboard. Nearly 20 core operational sequences, each with customized platform connectivity, were also designed by Mr. Wolf and his team.

Finally, in addition to being open and central to all systems, the building management system can evolve over time to continue to support the campus through changes and additional automation of tasks.

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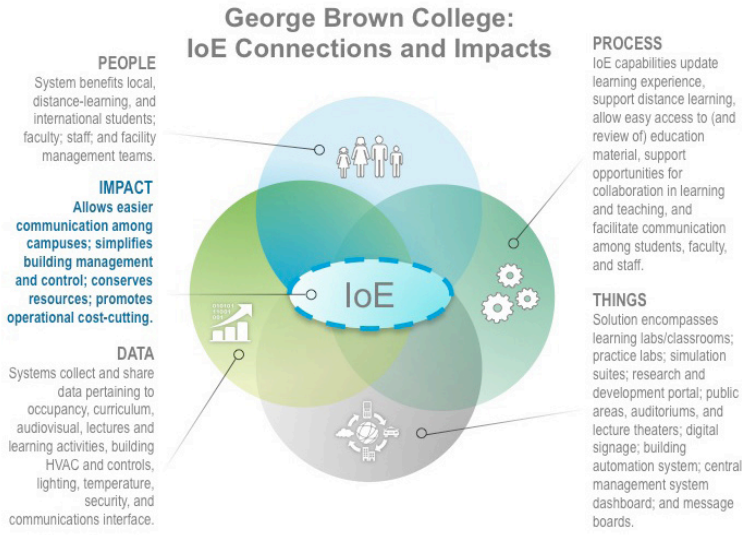
**Figure 1.** George Brown College: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

The Waterfront Campus Centre for Health Sciences has been widely praised for its unique environmental remediation solution and urban design, transparent vertical campus architecture, and the team approach to advanced technology. The building is a winner of numerous local and international awards.

### Network Platform

Even though creating the custom network platform and subsequently layering technology was a challenge, Ms. Comeau expressed tremendous enthusiasm for

the implemented solution, stating that the technical adaptability of the platform, efficiency of use, convenience for the facility management team, potential long-term cost savings, and, most important, the future-proofing are well worth the time invested. “Through Michael and his team, we were able to create and customize a universally flexible, future-forward technology platform. It takes an immense amount of time to implement. However, the system is just now starting to really reap the anticipated rewards of energy conservation, simplicity of access, remote access, and the ability for the facility and technology operators to see and understand what is happening across all systems. “Future flexibility is what it is all about – being able to layer additional applications that we can’t even envision yet. Really, it’s quite astonishing what we can do, and we haven’t even seriously tapped the potential yet,” she concluded.

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## Audiovisual Technology

Thinking of the campus audiovisual platform as emerging broadcast technology was a breakthrough for the design team. Simply put, broadcast switching technology facilitated the plug-and-play, anywhere-anytime performance of the system. Ms. Comeau gave an example: “If you were a nursing student and you had a video that showed you how to do a certain procedure, you could watch it in a classroom. You could then watch it again in a debriefing room. You could work with a small group in the library in a multimedia group work area, and you could practice that technique there, or you could sit while you were waiting for your ride in the lobby and rerun it again. You can review it at home as you study.” Having universal Wi-Fi access enables modern students to study and learn anywhere, anytime.

Having remote access to coursework content and video is also critical for GBC’s commuter students. Ms. Comeau explained that “literally 90 percent of our students come in from long distances by transit. We have a really rough climate and have had a particularly rough winter this past year. So, a young mother, for example, who is a nursing student and may have an ill child at home or can’t get here in the middle of winter can now go online, download the lecture or the particular learning experience, and work from home or an alternative environment. This technology also supports her participation in group work, faculty interaction, and collaboration.”

Lastly, with advanced audiovisual capabilities, GBC is able to increase international presence and support learning on other campuses, such as those in India and China. GBC’s network also assists more than 15,000 distance learning students by providing equal access to educational content and uniform teaching access across many learning environments.

## Building Management

Building automation, the central management system server dashboard, and sensor technology provide convenience, conserve energy, save costs, contribute to the safety of building occupants, and simplify building management.

 

## Lessons Learned / Next Steps

GBC tackled numerous challenges in the construction of the Centre for Health Sciences building. Ms. Comeau and Mr. Wolf indicated that extensive research and planning were essential to their success. The Waterfront campus network design project benefited from their efforts to gather and implement information regarding everything from utility usage to bandwidth to furniture. An early start to network design, an early commitment to integration, and value engineering were essential. Leaving sufficient time for building automation integration and testing at the end of the hard construction period was also extremely important for success.

"The idea is that we will, sooner rather than later, get to the point whereby live video transmission of academic content, full online learning capability, and distance learning become robust realities."

Terry Comeau,
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Waterfront Development,
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The team dealt with tight scheduling (due to a funding deadline) by layering some activities that are typically conducted sequentially. For example, architectural and interior designs were drawn up while the reclaimed ground was being remediated and prepared for groundbreaking. Additionally, multiple technology teams were contracted to simultaneously complete technology infrastructure spaces, such as computer rack and communication rooms, while the network was being created and tested.

In terms of future plans, GBC will continue its Intelligent Buildling quest and incorporate integration elements into other campuses and future buildings. According to Mr. Wolf, the AV switch – considered to be crucial to the audiovisual and other technical capabilities of the GBC Waterfront campus building – will soon be adopted as a standard within GBC campus buildings.

Making audiovisual streaming content available internationally is one of the college's next steps. At this point, extensive audiovisual content is not yet transmitted via live feed because the content has to be created, edited, and packaged, and staff have to be instructed in use and privacy protocols. Practical considerations such as technology in other countries and time zone differences have to be overcome. However, Ms. Comeau added, "The idea is that we will, sooner rather than later, get to a point whereby live video transmission of academic content, full online learning capability, and distance learning become robust realities. We'd like to be able to get to a point where perhaps one student group member is in India, one in China, one in Toronto, and not only are they learning about the particular task at hand, but they're also learning about how culturally different groups approach healthcare and work together. That's the dream that we are working toward."

## More Information

For more information, please visit http://www.georgebrown.ca

 

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# Guayaquil Harnesses IoE to Offer Telemedicine and E-Government Benefits to Citizens



**EXECUTIVE SUMMARY**

### Objective

- Improve the lives of residents, and help them succeed in the new information economy

### Strategy

- Partnered with private companies to mitigate challenges
- $2.5 million investment to initiate program, with no federal government support
- $2.5 million per year for next five years to complete Internet access program for the whole city
- $5.25 million yearly to provide students with tablets and computers
- $100,000 in 2014 for hospital and clinic telemedicine and government information kiosk programs

### Solution

- Initially, 50 free Wi-Fi hotspots; eight connected kiosks (similar to ATM machines) to provide Internet access to residents; telemedicine program that allows patients to receive remote diagnoses and treatment by specialists

### Impact

- Citizens with limited economic and physical mobility no longer need to travel across the city to see a specialist
- Free Internet access and telemedicine program have given citizens more confidence in local government
- Program investment will eventually benefit municipal coffers

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases — how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions — federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) — to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Digital Guayaquil

Guayaquil, Ecuador, a city of 2.5 million with up to 300,000 daily itinerants, faces a number of educational and poverty challenges. Only 44 percent of citizens have Internet access through local telecommunications companies, but its forward-thinking mayor is investing in technology and connectivity to make Guayaquil the first large metropolitan area in South America to be a digital city. The city is growing its free Internet access for citizens, connecting hospitals and clinics, providing e-government solutions, and investing in computers, tablets, and Internet access for public schools and universities.

Mr. Xavier Salvador is director of the Informatics Department in Guayaquil. He started his career as a teacher who studied computer science to help students learn technology and computers. In May 2003, the mayor of Guayaquil appointed Mr. Salvador to his current position.

"The mayor wants every citizen converted into a digital citizen. We have information from economists, newspapers, and IT consulting firms saying that there will be some sort of disruption because of the new technology. Many people will be unemployed in the future. The mayor is really concerned about that, and he's trying to [give people] the instruments, so the people in this city will be better prepared for the future."

Xavier Salvador,
Director of Informatics Department,
City of Guayaquil

## Objectives

The overarching goal of the city's efforts is to improve the lives of residents and to help them succeed in the new information economy.

Digital Guayaquil started in 2004 with the vision of extending digital literacy and Internet availability to residents by providing computers and Internet access to high schools and universities; giving hospitals telemedicine capabilities; and connecting residents of Guayaquil to the Internet through city Wi-Fi projects and government kiosks. In addition, the city of Guayaquil is offering government services over the Internet. In October 2013, the city announced a goal to provide Internet coverage to the entire city of Guayaquil within five years.

"The mayor wants every citizen converted into a digital citizen," said Mr. Salvador. "We have information from economists, newspapers, and IT consulting firms … saying that there will be some sort of disruption because of the new technology. Many people will be unemployed in the future. The mayor is really concerned about that, and he's trying to [give people] the instruments, so the people in this city will be better prepared for the future."

## Strategy

The Digital Guayaquil program is operated by the Guayaquil City Government. The Informatics Department, headed by Mr. Salvador, consists of 62 employees, with some positions staffed 24 hours a day to provide network support.

Mr. Salvador says that bringing Internet access to the citizens of Guayaquil has been challenging. To mitigate this, Guayaquil partnered with private companies whose experience Mr. Salvador characterizes as invaluable.

The city is investing $2.5 million to initiate the program, with no federal government support. The amount covers technicians; security; operators for servers, routers, and equipment; and employees based directly at City Hall. "We have a development department for our program. Many times we buy, but some things we have to

develop ourselves," Mr. Salvador explained. In addition to the $2.5 million in initial funding, the city has budgeted another $2.5 million per year for the next five years, totaling $12.5 million, in order to complete its citywide Internet access program.

Mr. Salvador indicated the city is further spending about $5.25 million per year to provide public school students and high schools with tablets and computers. In addition, according to Mr. Salvador, the hospital and clinic telemedicine and government information kiosk programs will cost the city about $100,000 in 2014.

## Solution

With Internet penetration at roughly 44 percent of the population, the city decided to increase Internet access by providing 50 free Wi-Fi hotspots around the city. "Most of these are educational sites," said Mr. Salvador. "The motivation is to have students get access to the Internet for study purposes." The hotspots have filters to limit access to violent and pornographic content. Additionally, the government has a program to provide tablets to secondary-school students.

Guayaquil is also connecting municipal hospitals in the city to expand medical services via telemedicine capabilities. In full operation for the past eight months, this program allows patients to receive diagnoses and treatment by specialists at major hospitals, eliminating journeys and wait times.

Next, the government placed eight connected kiosks (similar to ATM machines) around the city to provide Internet access to residents. These kiosks allow residents to conduct business with the city, such as making payments for city utility services and purchasing land-use and other permits. Citizens can also find information about city government structure and processes. Based on the initial success of the program, Guayaquil plans to install 12 more kiosks throughout the city.

Guayaquil is also connecting municipal hospitals in the city to expand medical services via telemedicine capabilities. In full operation for the past eight months, this program allows patients at local clinics to receive diagnoses and treatment by specialists at major hospitals, eliminating difficult journeys and wait times.

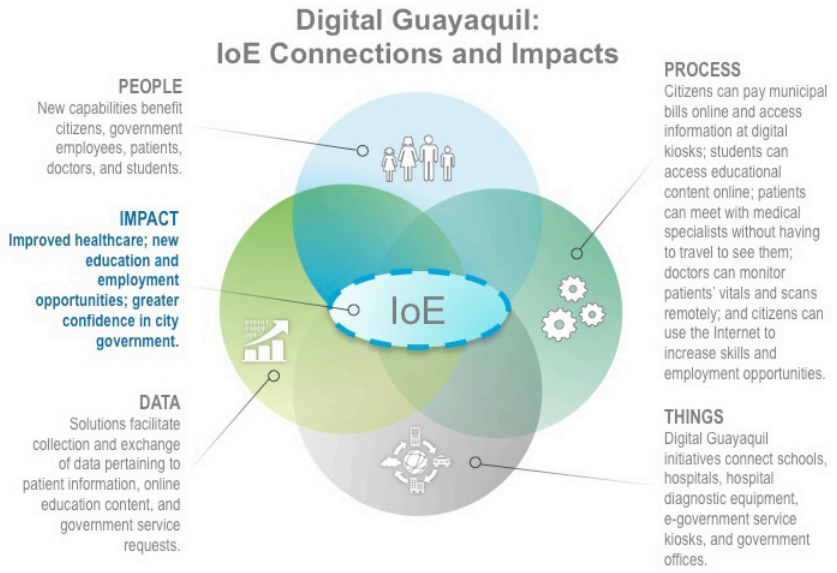
"[Patients] can be reached by a specialist from another hospital and no longer have to travel to see the specialist," Mr. Salvador explained. "It is a connection between the eight hospitals of the municipality. [Doctors] can monitor blood pressure, heart rate, and other signs remotely." Doctors also have the ability to perform certain types of internal tests.

In order to provide these services, the city utilizes a fiber-optic network provided by one of the local telecommunications companies. Outside contractors who operate a Network Operating Center, or NOC, provide network support, which keeps operational costs down.

Citizens are not only more educated about opportunities Internet access brings, but Mr. Salvador also says the program is an investment that will benefit municipal coffers in the future.

**Figure 1.** Digital Guayaquil: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

According to Mr. Salvador, the free Internet access program has been received very positively because it is a tangible benefit. Mr. Salvador said that the most basic way to get citizens to take advantage of Internet resources is to personally assist them in navigating to relevant training and educational resources. "Asking people, "What do you want to do with your life? Do you want to be a doctor? Okay, this is the site on the web that can help you .... You want to learn another language? Use iTunes, you will find very good lessons in English for free.' With this type of training, people will learn where to find things. The internet is a big place, and some people get lost in there." An educational television program also teaches citizens how to get the most benefit out of the Internet. "We need to educate people to use the technology in the best way," Mr. Salvador said. "We are working on two TV programs for that .... The people have to use this technology to get a better life."

The benefit of telemedicine connecting hospitals and clinics is that citizens with limited economic and physical mobility no longer need to travel across the city to see a specialist. Along with free Internet access spreading through the city, this benefit has given citizens more confidence in local government. "We see that the people [are] astonished," said Mr. Salvador. "Now they have confidence in the way that the mayor is helping them. It's very good to see the people happy for this – for the technology that we are using to help them."

Citizens are not only more educated about opportunities Internet access brings, but Mr. Salvador also says the program is an investment that will benefit municipal coffers in the future. "As soon as the citizens know more, they can build their own

businesses, right? In the future, they will provide the taxes that the city collects. It's not a direct [benefit]. The vision of the mayor is to help the people, and that pays later."

According to Mr. Salvador, cooperation from individuals within the government is critical: forward-thinking attitudes and power are needed to ensure a successful project.

## Lessons Learned / Next Steps

According to Mr. Salvador, cooperation from individuals within the government is critical: forward-thinking attitudes and power are needed to ensure a successful project. "First, you have to find people to help because you need people in the local government," he said. "You need to find people who are convinced that this is good for the citizens."

Partnering with private-sector companies whose specializations can guide the process is also integral to Guayaquil's success. This is due to the combined vision of end goals from the city and the experience of tech partners.

Lastly, Mr. Salvador says that having smart infrastructure and services is not enough if citizens cannot take advantage of it. Educating the public about how to utilize the smart technology – whether e-government portals or Internet-connected devices – is vital to the project.

## More Information

For more information, visit http://www.guayaquil.gob.ec

# Metrolink Employs IoE Capabilities to Improve Safety, Increase Fuel Efficiency, and Plan More Effectively



**EXECUTIVE SUMMARY**

### Objectives

- Successfully implement Positive Train Control (PTC) technology to avoid rail accidents

### Strategy

- Adopted aggressive technological upgrade to implement PTC
- Contracted with multiple parties to run rail line; other contractors provide maintenance and IT support

### Solutions

- PTC utilizes train location data provided over multiple redundant networks to inform automatic braking systems, which activate if a collision is imminent

### Impact

- Improved rail travel safety
- Increased fuel efficiency
- Reduced headways (space between departing trains)
- Ability to plan more effectively

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Metrolink

Metrolink is one of the first train operators in the world to implement the Positive Train Control (PTC) collision-prevention technology. PTC utilizes train location data provided over multiple redundant networks to inform automatic braking systems, which activate if a collision is imminent.

PTC utilizes train location data provided over multiple redundant networks to inform automatic braking systems, which activate if a collision is imminent.

Metrolink was created in 1992 by the Southern California Regional Rail Authority (SCRRA), a publicly owned joint powers authority. It is governed by an 11-member board representing the transportation commissions of Los Angeles, Orange, Riverside, San Bernardino, and Ventura counties. Metrolink provides transportation throughout six counties in Southern California, transporting passengers via a network that includes seven service lines and 55 stations spread across a 512-route-mile network. Metrolink handles approximately 44,000 daily boardings.

Jay Peterson is manager of Metrolink's Positive Train Control Network Architecture. He worked for 10 years as Metrolink's manager of information technology, and prior to that as the director of information technology for the Riverside Transit Agency. Mr. Peterson has a background in computer science.

## Objectives

In 2008, Metrolink experienced a devastating rail accident with multiple fatalities, the worst in its history. The accident prompted the U.S. government to enact the Rail Safety Improvement Act (RSIA), which requires all U.S. railways to implement Positive Train Control technology to avoid such incidents.

## Strategy

Metrolink has adopted an aggressive technological upgrade to implement PTC, which is to be completed and operational in late 2014. The budget for the PTC initiative is roughly $210 million. This includes approximately $120 million allocated to the main subcontractor for the PTC system. The subcontractor is responsible for coordinating the installation of the program infrastructure and software systems. Mr. Peterson indicated that Metrolink is installing fiber-optic cabling, the network infrastructure, and the microwave equipment at a cost of several million dollars. Most of the remainder of the budget is being applied toward support to deliver the work. Funding was publicly raised and is primarily from local sources, but the project also received some federal grants.

Operationally, the actual Metrolink staff is small; the company contracts with multiple parties to run its rail line, and other contractors provide maintenance and IT support.

Metrolink holds regular press conferences, including a large rollout for PTC with a demonstration of the technology. It issues regular newsletters and updates on the progress, and press is generally positive.

"What we're really trying to do is move the intelligence of the railroad to the onboard locomotive, and give it the ability to understand where it's at and what's in front of it."

Jay Peterson,
Manager,
Metrolink Positive Train Control Network Architecture

## Solution

Mr. Peterson described the technology involved in the PTC system as "path diverse and technology diverse." The various technologies involved include a central control center or "back office"; onboard triplex computers; and a proprietary radio system for communication among the back office and each train, control points, and signals installed along on the wayside. A number of redundancies are built into the systems to provide backup in critical situations.

"What we're really trying to do is move the intelligence of the railroad to the onboard locomotive, and give it the ability to understand where it's at and what's in front of it," Mr. Peterson explained. "We're using a lot of telemetry within the train itself. It's got GPS. It's got basically a speedometer or odometer running so it can keep track of itself. Because we have some very good accurate surveys of the rail itself – where it is, its elevations, its speeds – we keep that in what we call a track database."

In this way, each train not only keeps track of itself, but the master system monitors each train as well and provides data to a control center. Dispatchers can see where each train and other trains are on the network. Dispatch and supervisory personnel in the control center can also monitor where the trains are. In addition, with PTC, the trains themselves are keeping track of the traffic on the network. In this way, there are three layers of monitoring, all aimed at ensuring trains do not collide.

According to Mr. Peterson, PTC does not actively control the train under normal conditions; in virtually all settings, engineers still manually control the trains. PTC works only as a backup system that will apply emergency brakes if it senses an imminent collision.

Mr. Peterson explained the redundancies throughout the system, saying, "This is a safety-critical system that we're putting in. When you look at failure-type scenarios and the critical nature of the safety itself, we want to ensure that the communication links are redundant, and there are multiple ways to communicate."

### Back Office Computer Aided Dispatch System

The back office employs a Computer Aided Dispatch (CAD) system and several dispatchers to communicate with each train engineer and conductor. The CAD system includes detailed mapping information of the system's rail lines, with communication links to the wayside control points, signal systems, and crossing monitoring systems. "They have a picture of the field," explained Mr. Peterson. "They talk to the engineer in the field. Commuter trains have a schedule to keep. We know what it is and use it to aid in moving additional freight trains through the network. To move the freight trains, we need additional data from them, such as how many loads they've got, how many cars they've got, how many tons they've got."

Mr. Peterson added, "The dispatcher can look at occupancy. He can watch his CAD displays and look at the track, and he will get an indication from the field that says this train is located within this track segment. The dispatcher can then set the route within the CAD system to wherever the train is destined. That will then talk to the

field, will clear up signals, move switches back and forth, whatever the dispatcher requests to be able to move that train along."

From the CAD system, the information is translated to the BOS, or "back office server" system. Information from the BOS is sent to trains via a 220 network infrastructure or Wi-Fi, depending on the train's location or the station from which it is departing. "That BOS is produced by the same company that produced the onboard train management computer (see below)," Mr. Peterson explained. "Now it interprets all of that using the track database, and builds what they call track clearances, so that they can actually move the train. The onboard system then receives those authorizations to move and knows where the train is going. He now has authorization to run."

"The CDU basically helps us control which file sets are brought down and which file sets are actually running on board, and brings those file sets in and out from the back office. They're all communicating together. It's all basically its own little area network."

Jay Peterson,
Manager,
Metrolink Positive Train Control Network Architecture

## Onboard Train Management Computer

Mr. Peterson explained that each train carries a train management computer (TMC), which, Mr. Peterson explained, is actually "a triplex set of computers that basically 'votes' on critical functions. It is a failsafe device — a vital component within the system. That vital component is what has the ability to stop the train if it thinks there is something unsafe. It is wired into the braking system."

The TMC interacts with the BOS through the computer display unit (CDU). Mr. Peterson explained the function of this portion of the TMC: "The CDU basically helps us control which file sets are brought down and which file sets are actually running on board, and brings those file sets in and out from the back office. They're all communicating together. It's all basically its own little area network."

Mr. Peterson explained the method of operation between engineer and the triplex computer: "The engineer on board has to interact with the TMC. As he's looking down the right-of-way, it tells him what's coming up in front of him from a signal perspective — whether he needs to be able to stop the train, or if he's going over speed, or if he's approaching a worker zone where you have reduced speed. If the engineer doesn't react properly by slowing down the train, the TMC has the ability to stop the train."

## BOS/TMC Communication

One communicating link between the BOS and TMC systems is the proprietary PTC radio system developed by Meteorcomm (MCC), a coalition company created by the Class I railroads. The system utilizes the 220 MHz radio frequencies for onboard, wayside, and base station communication. It uses both CDMA and TDMA technologies in transmitting and receiving data with each train.

Trains also carry cellular modems, and many have two cellular modems as a safety redundancy. In the case of two modems, each modem is path diverse, with each using a different telecom operator for service. Communication from the trains is on a private cellular network and delivered to the back office via dedicated MPLS links.

Trains are equipped with 802.11n Wi-Fi, which Mr. Peterson explained is particularly useful in areas of heavy traffic. "When we come into a heavy location such a one of our maintenance yards, or one of our dispatch points such as L.A. Union Station,

"One of the big things about Positive Train Control has to be this interoperability piece: we have to be able to operate on other people's railroads, and they need to be able to operate on ours."

Jay Peterson,
Manager,
Metrolink Positive Train Control Network Architecture

we have Wi-Fi access to slow the train down so we can do diagnostics. We can get logs, or they can actually do what we call an initialization through it. So if it needs to pull down files or update itself or something like that, it has the higher bandwidth to be able to do that."

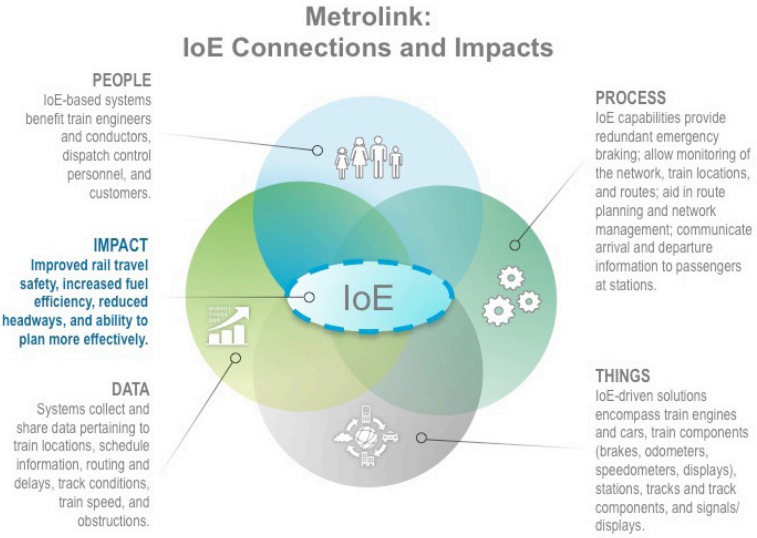
## Communication with Other Railways

The Meteorcomm Interoperable Train Control Messaging (ITCM) system will be the primary message transport tool in the industry. Mr. Peterson said, "It's actually a layer 4, 5, and 6 messaging system that interconnects not only the trains with our back office, but it also interconnects our back offices with other railroads. We run the L.A. Basin for the most part. We control a lot of track here, but we have a number of partners that run across our railroad, and we run across theirs. One of the big things about Positive Train Control has to be this interoperability piece: we have to be able to operate on other people's railroads, and they have to be able to operate on ours."

Mr. Peterson described the importance of this compatibility portion of the technology, saying, "For instance, when we come out of our L.A. Union Station, we come out on our own track for about two or three miles. Then we may jump right onto the Union Pacific Railroad (UPRR) tracks or the Burlington Northern Santa Fe (BNSF) track. At that point, our train has to talk to our partner's back office as well as our back office. Now we are running on their track and being dispatched by that other railroad."

Mr. Peterson described the scale of the industry-wide initiative, saying it includes a large number of rail service and IT service and infrastructure providers. While he believes Metrolink has progressed further than others in the industry, Mr. Peterson stated that Metrolink's implementation of PTC is still "heavily ... in the testing phase." Metrolink is currently conducting compatibility tests with BNSF, and preparing to test with Union Pacific and Amtrak.

**Figure 1.** Metrolink: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

Improved rail travel safety is the primary focus of PTC systems, although there are other benefits as well. The technology is expected to increase fuel efficiency as system data gives train operators the ability to better manage and stabilize speeds. "[The TMC] will have the information of how long it's going to take to get to its next point. [The engineer] won't have to necessarily go full throttle up to one point and then stop for an hour. It would be better to have him run at maybe 25 miles an hour for a distance, and get there and be able to proceed," Mr. Peterson explained.

Reduced headways, defined as the space between departing trains, is another expected improvement. "Our headways right now are anywhere down to 20 minutes, which is pretty tight for a heavy rail system," Mr. Peterson said. "We think by the data that we will be able to gather – both from a maintenance perspective, as well as how well we can run through each segment of track – that we are going to have much more granular information on the movement of the trains themselves, and that we will be able to do better planning."

"This is not going to cure all rail accidents .... But what it *is* going to help us understand is how the trains move and how we can better control that. And it will jump in if it does think there's something unsafe, and it will stop the train."

Jay Peterson,
Manager,
Metrolink Positive Train Control Network Architecture

## Lessons Learned / Next Steps

Mr. Peterson said that misunderstandings often arise among the public from the newness of PTC technology, and from a lack of comprehension regarding its limits. "One of the key challenges is how do you communicate and help people understand what we're trying to accomplish? Sometimes there is an assumption that this is going to cure all rail accidents.

"This is not going to cure all rail accidents," Mr. Peterson continued. "We still can't prevent a car from going around a grade crossing and getting hit by a train, or a person walking out in front of the train, or walking down the right-of-way with headphones on. It's not going to solve those kinds of accidents. But what it *is* going to help us understand is how the trains move and how we can better control that. And it will jump in if it does think there's something unsafe, and it will stop the train. Is it the 'end-all' type of thing? No, but it is definitely a very good step in the right direction. The challenge is to make people understand where the industry is going."

According to Mr. Peterson, one of the most formidable challenges with PTC arises from the vagueness of the law that requires it, and from the extra layer of reporting on top of the technology. "[RSIA] is very broad, and it's very limiting all at the same time," he said. "If you read the law itself, they don't tell you necessarily how to do some things, but they tell you what the result has to be. There are a number of documents that we have to produce. All railroads are going to have to produce a safety plan. There are a number of other papers that we also have to publish, but that's going to be one of the biggest ones."

Being the first in the industry to implement the technology presents other difficulties. "Putting together a technology product that is so diverse and widespread across our entire system is a big challenge, along with getting people up to speed on how to use it and how to maintain it," Mr. Peterson said. He gave examples of everyday

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Jay Peterson,
Manager,
Metrolink Positive Train Control Network Architecture

difficulties such as "making sure the train has the right software onboard," and "making sure the radios are programmed to talk on the right channel at the right time."

Cost is another issue, affecting not just Metrolink but all railways. According to Mr. Peterson, "This is a technology that is going to be throughout the U.S. It's already being deployed in other countries as well. People really need to understand it's not just the money up front. It's also going to be the ongoing maintenance and support of it in the future. A lot of that is also going to go back to really understanding and documenting your actual railroad – understanding how you do business, and then how this is going to change how you do business. That is really going to be one of the key things that the industry has to understand."

Mr. Peterson emphasized the importance of system redundancy, indicating that a "technology-diverse" system creates a more stable environment. In addition to redundant technology on board each train and within the back office, Mr. Peterson described the construction of a new primary data and dispatch center, which will be used in addition to the current center. "We are now building a Train Control and Operations Center," he said. "It's located about a mile away, but still right on our own right-of-way." Plans are for the current center to become a secondary center, called the Metrolink Operation Center (MOC).

Two operational centers mean that all data will lie in two separate systems. Metrolink is now in the midst of what Mr. Peterson describes as "a very robust overhaul of our backhaul network" of data to duplicate the systems communicating with each train. Mr. Peterson explained the complexity of such a project: "To build this backhaul to every node on the network, every control point out there – every wayside signal location, every base station – has to be connected into the network two different ways, using two different technologies. At some locations we are using Ethernet radio and cellular. Other locations we have hooked up directly on fiber; we have fiber running along a number of miles of our own right-of-way. We also have built a microwave network to get some of our outlying areas back into the network backhaul."

Mr. Peterson said that the benefits of granular information regarding train scheduling and performance is not only valuable for operational purposes, but is useful for commuters as well. He is studying ways to link real-time train data into Metrolink's customer information system. "We are looking at really tying our customer information system into some of the benefits of PTC," Mr. Peterson said. "Because we know where the trains are. The trains all have GPS on them now. We get those position reports back to our back office. Our plan right now is we are going to utilize that data to drive our customer information systems." As part of this process, Mr. Peterson intends to link the information to platform signage, and drive the displays directly from the CAD system, including arrival and departure times, tracks, and other updates.

"Our ability to manage our field is going to intensify because of this effort," Mr. Peterson concluded. "Our ability to do remote diagnostics for most of our equipment is completely changing, given our new access into all the different equipment that's

 

in the field, including the onboard system [and] being able to mine that data to really tend locomotive health and on-time performance. It's going to revolutionize the industry."

## More Information

For more information, visit http://www.metrolinktrains.com

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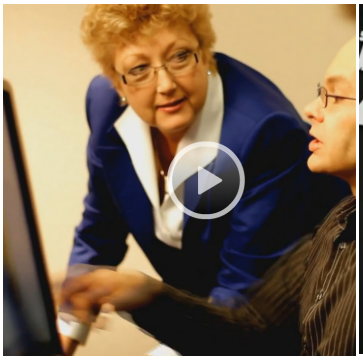
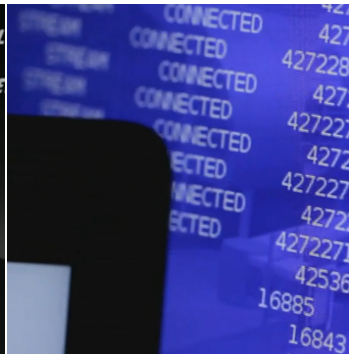
# Michigan Cybersecurity Initiatives Reduce Risks Through Improved Employee Training




## EXECUTIVE SUMMARY

### Objectives

- Reduce security risks through better-trained employees and residents
- Coordinate with private sector regarding critical infrastructure and cybersecurity
- Create opportunities for ongoing education and security

### Strategy

- Coordinate with Michigan State Police and other governmental parties responsible for statewide emergency management

### Solutions

- Online and group training of state employees
- Cyber Range allows technological staff to practice data security exercises
- Cyber Disruption Strategy formed in collaboration with both public and private entities to address possibility of large-scale cyber attack

### Impact

- Garnered "A" grade in 2012 NASCIO Digital States Awards, one of only two states so honored
- Better-trained employees and residents; reduced security risks
- More than a dozen serious cyber threats avoided; decreased damage due to malware and phishing scams
- Estimated program ROI: more than 100:1
- New opportunities for ongoing education and security

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

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The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About the State of Michigan

The State of Michigan has implemented a series of cybersecurity initiatives that place it among the top U.S. states for data security awareness and education. These initiatives include an innovative and entertaining employee training program, a Cyber Range where technical specialists learn to counter security threats, and regular public/private collaboration in the creation of the Michigan Cyber Disruption Response Strategy.

Dan Lohrmann serves as chief security officer, chief information security officer, and deputy director of cybersecurity and infrastructure protection (CIP) within the Michigan Department of Technology, Management and Budget (DTMB). Mr. Lohrmann has worked in a variety of public sector security and leadership capacities, including work for the National Security Admininistration (NSA). He was chief information security officer (CISO) and chief technology officer (CTO) for Michigan before assuming his current position.

The State of Michigan has implemented a series of cybersecurity initiatives that place it among the top U.S. states for data security awareness and education.

Andris Ozols is a senior policy adviser and analyst for the State of Michigan Department of Information Technology. He has more than 42 years of experience as a Michigan public employee.

## Objectives

The primary objective of Michigan's cybersecurity initiatives was to reduce security risks through better-trained employees and residents. The state also sought to coordinate with the private sector regarding critical infrastructure and cybersecurity, and to create opportunities for ongoing education and security.

## Strategy

The State of Michigan chief security officer and the Michigan Department of Technology, Management and Budget are responsible for the overall administration and maintenance of the state's cybersecurity initiative plan and implementation. These efforts are coordinated with the Michigan State Police and other governmental parties responsible for statewide emergency management.

Most funding for Michigan cybersecurity initiatives is public, using a variety of both state and federal sources. This includes grants from the Department of Homeland Security and resources available through collaboration with higher education entities.

- Cyber Summits and Breakfast Conference events are self-supporting through sponsorships and fees for attendance.
- The Security Mentor online training program was established for under $200,000, estimated at a per-employee cost of about 30 cents per lesson over a two-year period.
- The Michigan Cyber Range was created with the assistance of $2 million in private donations and grants, with an additional 20 percent of total funding provided by government sources. It is expected that the state government is saving 40 to 50 percent in certification, course, and travel costs through use of the program.

## Solution

As Michigan's chief security officer, and in cooperation with Michigan Governor Rick Snyder, Mr. Lohrmann oversees the state's cybersecurity program, The Michigan Cyber Initiative. Components include online and group training of state employees; a "Cyber Range" setting that allows technological staff to practice data security exercises; and a Cyber Disruption Strategy formed in collaboration with both public and private entities – such as large employers, utilities, and federal agencies – to address the possibility of a large-scale cyber attack.

### Employee and Public Training

The state's bimonthly online cybersecurity training program is the core of its employee training system. Mr. Lohrmann's organization also holds Security Summits and a Breakfast Conference Series, and publishes a monthly newsletter.

In beginning the online training program, Mr. Lohrmann first surveyed employees to determine the effectiveness of the existing program, which consisted largely of emailing messages containing hyperlinks to security information videos. The results weren't encouraging.

"We went from about 10 percent of state employees actually taking the training in the last 12 months to well over 90 percent. We were delighted with the number of people who went through the training."

Dan Lohrmann,

Chief Security Officer, Chief Information Security Officer, and Deputy Director of Cybersecurity and Infrastructure Protection,

Michigan Department of Technology, Management and Budget

Mr. Lohrmann recalled, "In some test studies, people were starting the videos, then going down the hall, getting a cup of coffee, heading to the restroom, coming back, talking about the game last night, and hanging out. They weren't even watching the videos. That was not good. We wanted it be interactive. We wanted people to really engage with the training, and most of all, we wanted it to change behavior. It wasn't just about checking the box and saying, 'Yes, I took the cybersecurity training.'"

To find a better way to engage state employees, Mr. Lohrmann followed up with a second survey. "We put together a team to determine what people wanted in the training. People said they wanted it to be timely. They didn't want a two-hour or even an hour-long training at their desk. People wanted it to be brief but frequent. They wanted it to be updated regularly. They wanted it to be intriguing. They wanted it to be fun."

Mr. Lohrmann said DTMB issued a Request for Proposal (RFP) for a more interactive training experience, challenging vendors with the question: "How can we actually change behaviors and have metrics around that?"

DTMB selected a vendor program that used games and interactive activities focused on promoting safe behaviors in a variety of settings. The program was rolled out to all state employees over six months with an outstanding response and positive feedback. "We went from about 10 percent of state employees actually taking the training in the last 12 months to well over 90 percent. We were delighted with the number of people who went through the training."

"Most astounding was that the feedback was just fantastic," Mr. Lohrmann continued. "People said, 'We love this, it's the best thing to ever come out of the technology department,' and we got really wild comments like, 'This is incredible, can I bring it home? Can I show it to my family? Can I use it with my kids?' After every lesson ... they give a grade from one to five, with five being awesome, one

being they didn't like it. With 50,000 state employees, we're averaging over four, which is unheard of in this space."

Mr. Lohrmann explained the appeal of typical training exercises: "One of the games that I liked the best covers the importance of your role in your office, which teaches employees to find security violations such as leaving confidential papers on desks. Then you classify why something was a policy violation or a security violation." Another game involves a Super Mario type of character who runs around an airport looking for 12 lost or stolen laptops. "It's like a countdown – you have 90 seconds," Mr. Lohrmann explained. "The first time I played it, I think I found seven of the 12."

Mr. Lohrmann said the most important aspect of the training is its highly memorable nature. "The idea is to change behaviors; when I go into airports now, I actually can't stop thinking about that Super Mario game," he said. "Whether you're at the ticket counter or the security gate, you think about this stuff. Employees just love it. People say they look forward to taking the lessons."

"The goal was to make it a public-private partnership – to bring in universities and our federal partners to help determine how we prepare to defend our networks and systems against the best and brightest in the world."

Dan Lohrmann,

Chief Security Officer, Chief Information Security Officer, and Deputy Director of Cybersecurity and Infrastructure Protection,

Michigan Department of Technology, Management and Budget

## Michigan Cyber Range

In an effort to provide more technical training to IT staff, Mr. Lohrmann sought to re-create a cybersecurity testing environment similar to the ones used during his tenure with the NSA. "The idea was to set up an organization and a training, which we call the Michigan Cyber Range," he explained. "The Cyber Range provides a place to test and train and learn and grow in an unclassified environment. The goal was make it a public-private partnership – to bring in universities and our federal partners to help determine how we prepare to defend our networks and systems against the best and brightest in the world."

According to Mr. Lohrmann, the Cyber Range provides technical training covering topics such as ethical hacking and different types of forensics at about half the cost of sending someone out of state to attend a similar training.

Mr. Ozols also emphasized the broad approach in planning, saying, "We consciously and deliberately take a statewide perspective working with local governments and entities. It is equally a part of our responsibility and in our vision and goals." Cybersecurity experts throughout the state and around the Midwest now use the site regularly, including the National Guard.

Mr. Lohrmann said that he first took his idea for a cyber skills test site to Governor Snyder, who strongly backed the project. Mr. Lohrmann then recruited a software firm to develop the test platform – an unclassified, logically isolated system that allows technical teams to learn data security techniques through a series of exercises.

Mr. Lohrmann's technical teams practice skills with a variety of tabletop scenarios, including "Alphaville," which Mr. Lohrmann described as "a small city." He continued, "It has a library. It has a power generation plant. It has a water plant, a city hall. You can actually hack into them and defend them." Government employees passing the courses are eligible for a variety of certifications.

## Michigan Cyber Disruption Response Strategy

According to Mr. Lohrmann, Governor Snyder is a great champion of cybersecurity. "He's really emphasized that cyber disruption is the greatest threat America currently faces .... Nuclear might be number one, but he says the most likely threat is cyber, because it's already happening."

In an effort to create a statewide security strategy, Mr. Lohrmann formed a planning coalition of representatives from key public interests and large employers throughout the state. "We meet monthly, and we have representatives from the top private sector companies in Michigan," explained Mr. Lohrmann. "We've got Consumers Energy, DTE Energy, and some banks. We've also got some auto suppliers and other major businesses in Michigan. We work together to build the cyber-response strategy around how to share information about cyber threats. How do we work together in an emergency? How do we declare an emergency? Who are you going to call? How are we going to coordinate?"

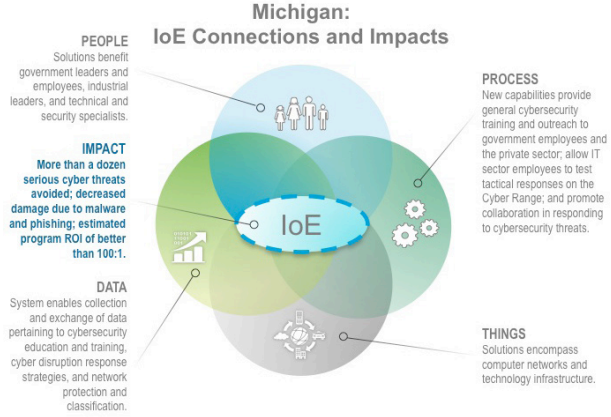
In an effort to create a statewide security strategy, Mr. Lohrmann formed a planning coalition of representatives from key public interests and large employers throughout the state.

The group publishes its conclusions online, in the Michigan Cyber Disruption Response Strategy, which has been named a National Best Practice by the Department of Homeland Security.

"This isn't just outreach and training," Mr. Lohrmann said. "The concept behind this is pretty new. State governments, historically, respond to fires, floods, tornadoes, emergencies. Now we've got potential cyber emergencies. Our Cyber Disruption Strategy was born out of a desire to prepare for a cyber disruption of statewide significance. What if the grid went down? How do we communicate before, during, and after an event? How do we work together with the private sector?" The strategy also includes policies on sharing cyber threat information, how to define an emergency, and a list of emergency contacts.

Mr. Ozols noted, "We're one of the first states to also look at industrial employment or economic development opportunities tied in with cybersecurity. We've spoken to a number of potential partners, including Canada, Israel, and so forth. This is also part of the outreach. It's part of the fact that we have more than a departmental life perspective – we have a statewide perspective."

**Figure 1.** State of Michigan: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

Michigan's cybersecurity initiatives garnered the state an "A" grade in the 2012 Center for Digital Government's Digital States Awards, one of only two states so honored. According to the award's website, Michigan "demonstrated results across all survey categories, and nimble leaders use modernization to implement strategic priorities and operational efficiencies. [These] states show evidence of meaningful collaboration; their performance measures and metrics are widely adopted; and their budget cuts tend to be made strategically."

Michigan's training efforts were also selected by NASCIO in 2013 as the top cybersecurity project among the 50 states. The details of this award can be found at www.nascio.org/awards.

Mr. Ozols pointed out that according to the NASCIO award document, "more than a dozen serious cyber threats have been avoided directly from efforts" related to the program.

The Cyber Range has been widely accepted as an advanced arena for training security professionals, and the National Guard uses the website for its own cyber training.

Michigan's data security measures serve as a model for other states to follow. Mr. Lohrmann explained the impact of the Cyber Disruption Response Strategy document on the national security community, saying it was designated a National Best Practice by the Department of Homeland Security. "This cyber framework is being used as an example of what states should be doing to coordinate with the private sector around critical infrastructure and cybersecurity," Mr. Lohrmann said.

Better trained employees and residents – and correspondingly reduced security risks – are the most prominent benefits of Michigan's cybersecurity training initiatives. Mr. Ozols pointed out that according to the NASCIO award document, "more than a dozen serious cyber threats have been avoided directly from efforts" related to the program. Damage due to malware and phishing scams have decreased, and, given the high costs of serious security breaches, Michigan officials estimate the ROI for the program at "more than 100-to-1."

In addition to training programs, the initiatives also include strengthened security in the form of improved IT infrastructure, including cabling, data networks, wireless, and mobile computing projects.

The initiatives also provide a training venue for nonpublic employees and non-Michigan residents as well, and the state website contains updated information available to anyone with online access. The Cyber Range program provides a venue for both state and national training in data security measures. In addition, Mr. Lohrmann's monthly meetings with industry executives and representatives of public infrastructure create a holistic approach to security that is being copied on the national level.

The programs also create opportunities for ongoing education and security. Outreach at local schools and the creation of cybersecurity initiatives in collaboration with Michigan universities provide an incentive for students to pursue skills and employment in data security fields. As Mr. Lohrmann noted, "Jobs and economic development could be a positive side of cybersecurity."

## Lessons Learned / Next Steps

Mr. Lohrmann explained that obtaining quantifiable benefits is always a challenge in measuring the benefits of security programs. “As far as our training, the hard part of this is you don’t know what you don’t know,” he said. “It’s like, ‘How many attacks did we stop? How many people didn’t do something they shouldn’t have done because they had the training?’ It’s hard.”

He continued, “We measure how many will take the training, what their reaction to it is. We ask them if their behavior changed. We do some testing around whether people click on links, for example. The problem with measuring success is that I could be doing really well in running these programs, but it doesn’t necessarily mean I’m going to influence the number of attacks against us. There’s no simple measure of security.”

“Most of all, when we think about data, we think about how people interact with the data, the processes we have around that data, and the technology we use to protect the data. From a cybersecurity perspective, people are a big part of that, and that’s why we do such much around training.”

Dan Lohrmann,

Chief Security Officer, Chief Information Security Officer, and Deputy Director of Cybersecurity and Infrastructure Protection,

Michigan Department of Technology, Management and Budget

Mr. Lohrmann acknowledged that today’s IT environment encourages the collection of vast amounts of data. He advised those seeking to create similar programs to remember that “not all data can be treated the same. You’ve got different types of data. There are lots of non-sensitive data and there are sensitive data. Know what data you have. Get a good handle on what data is important, how you’re protecting it, and how you can share the data. Have an inventory, know what it is, know where it is and what the purposes of it are. How long are you keeping it? How long are you storing it? Is it backed up? All of those types of things are essential.”

Identifying useful data and properly using it is a focus Mr. Lohrmann is attempting to refine. “We have a wider project on how we can share data better to get results and uncover fraud in government or uncover programs to better meet citizen needs, to connect the dots on providing better services to the people that most need help.”

Mr. Lohrmann also described the importance of encrypting sensitive data, “both at rest and in transit.” He said, “That’s a policy that took us a little while to implement, and we’re over 95 percent of the way there. We’re not 100 percent, but we’re doing much better than we were.”

Mr. Lohrmann concluded, “Most of all, when we think about data, we think about how people interact with the data, the processes we have around that data, and the technology that we use to protect the data. From a cybersecurity perspective, people are a big part of that, and that’s why we do so much around training. I’m not going to ever say that we’re going to be perfect, but we have to have people, process, and technology around that data, and we need to make sure we’re thinking long and hard about how we’re protecting citizen data.”

## More Information

For more information, please visit http://www.michigan.gov/cybersecurity

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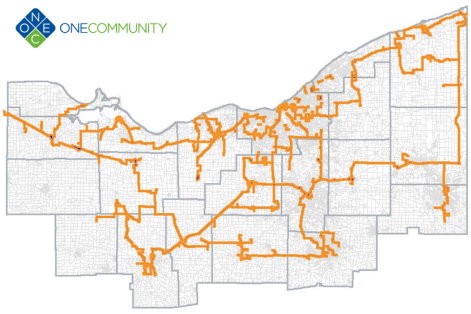
# OneCommunity's Ultra-High-Speed Network Expands Access to IoE Capabilities


## EXECUTIVE SUMMARY

### Objectives

- Leverage high-speed connectivity to improve quality of life and encourage technology-focused economic growth
- Expand access to information and public services, including healthcare, education, and government offerings

### Strategy

- Develop a unique, nonprofit, public-private governance structure
- Engage with communities to promote access among underserved populations
- Encourage pilots and experimentation for the public good

### Solutions

- Owns and operates 2400 route miles of fiber-optic cable
- Promotes public/private collaboration to foster competitiveness and economic growth, and to transform the area into a "smart region"
- Provides training, low-cost equipment, and affordable Internet access to low-income residents
- Promotes pilot programs that address community pain points

### Impact

- Fosters low-cost, creative, local solutions through collaborative business model
- Attracts new business and innovative startups by providing high-speed Internet access
- Increases educational opportunities by connecting school districts, higher education, museums, and libraries
- Improves access to healthcare information

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases — how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions — federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) — to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About OneCommunity

OneCommunity is an award-winning nonprofit organization operated in northeastern Ohio serving public and private sector entities, including governemnts, libraries, and educational and healthcare institutions. OneCommunity promotes a connected and smart community by providing next-generation broadband infrastructure and services. The organization seeks to 1) improve quality of life by utilizing high-speed connectivity to promote access to public services, 2) enhance healthcare and educational opportunities, and 3) encourage technology-focused economic growth. OneCommunity now manages more than 2400 route miles of optical fiber infrastructure.

Dr. Lev Gonick is co-founder and CEO of OneCommunity. Before his association with OneCommunity, Dr. Gonick was CIO for Case Western Reserve University. He has more than 25 years of experience in network technology. Dr. Gonick is widely recognized as an influential thought leader on connectivity and network innovation, and has received numerous honors and awards for his work in technology and the public sector.

"We shared a vision that was raised by a lot of important community stakeholders, which was the idea of constructing a next-generation network that would actually attend to the priorities of the community – areas such as education, healthcare, and neighborhood safety."

Lev Gonick,
CEO and Co-Founder,
OneCommunity

## Objectives

OneCommnity's goals include a desire to leverage advanced high-speed connectivity to improve quality of life and encourage economic growth. The organization leverages an open, high-speed network designed to expand access to information and public services, including healthcare, education, and government offerings. OneCommunity builds on a strong foundation of partnerships with local public and private entities to achieve its goals.

OneCommunity serves as a catalyst for the development of new community-focused technology and capabilities. OneCommunity also provides a test bed for development of new applications, including sensor-based applications spread across the OneCommunity network.

Dr. Gonick founded OneCommunity with the help of like-minded individuals, saying, "We shared a vision that was raised by a lot of important community stakeholders, which was the idea of constructing a next-generation network that would actually attend to the priorities of the community – areas such as education, healthcare, and neighborhood safety. These were the things that actual community members indicated were very high priorities. So this idea of creating a co-op or an aggregation strategy to advance community value attracted me."

## Strategy

### Technology

OneCommunity connects more than 700 organizations within its next-generation, ultra-high-speed fiber-optic network. The cabling for the network is typically aerially deployed using rented poles. OneCommunity also partners with its competitors, renting unused bandwidth to increase network access for customers.

According to Dr. Gonick, one of the advantages of the OneCommunity model is that it enables member organizations to access the fiber-optic infrastructure in ways not available in the private market. OneCommunity allows member organizations either to manage their own network infrastructure or have OneCommunity provide the management and engineering services necessary to keep the infrastructure running. As a result, OneCommunity differs from typical telecommunications companies that provide a fixed, managed product.

OneCommunity provides integrated network access across 24 counties in northeastern Ohio, a market that historically has had a number of disjointed telecom providers. With its single fiber-optic network, OneCommunity can provide seamless network services across the broader geographic region. This has become an additional benefit, particularly for OneCommunity members who have multiple connected sites throughout the area.

OneCommunity manages over 2,400 route miles of community-owned fiber, and connects more than 700 organizations within its next-generation, ultra-high-speed fiber optic network.

In addition to providing the broadband network, OneCommunity initiates, supports, and pilots educational programs that utilize end-point technologies such as video-conferencing devices and sensors for medical education, training, and patient monitoring. OneCommunity has also driven deployment of other sensor-based systems to monitor public health issues such as air quality and lead contamination.

## Governance

OneCommunity is a collaborative public/private nonprofit enterprise, with a 19-member board of directors chaired by Ray Voelker, CIO of the Progressive Group. “We are a nonprofit, community-owned network,” Dr. Gonick explained. “Our board is composed of presidents of community colleges, directors of county libraries, healthcare partners, university leaders, large employers of IT staffing in the community, and entrepreneurs.” The organization is owned by the member organizations that participate in the OneCommunity network.

Funding is received by member organizations, as well as via private donations and government telecommunications access grants. Recent funding efforts have yielded a $44 million grant under the American Recovery & Reinvestment Act for its Comprehensive Community Infrastructure program through the Department of Commerce. The grant was matched by $15 million in private funds and in-kind contributions. OneCommunity was also a recent recipient of an $18.7 million federal broadband stimulus grant.

## Community Engagement

OneCommunity conducts a variety of community outreach efforts, including projects to encourage disadvantaged individuals and families to “cross the broadband divide.” The group sponsors Connect Your Community, which provides computer skills training, low-cost access to equipment, and ongoing support. Connect to College Now, a similar, parent-focused digital learning and inclusion program, provides low-cost computers, training, and connectivity to disadvantaged parents and children within the Cleveland Metropolitan School District.

OneCommunity has attracted significant local and international attention for its unique business model, and Dr. Gonick concedes that an “enlightened” point of

view regarding public access is required to appreciate the vision of the organization. "We are indeed a very different type of model. There are a number of organizations around the world that have come here to look at the OneCommunity model. There's a One Maryland project that is modeled significantly after our work. In the United Kingdom, there is a One-Manchester initiative that had its origins in trying to create this hybrid model. There are similar programs and projects in New Zealand."

### The City as an Operating System

Part of the OneCommunity strategy is to see the city as an operating system upon which applications and solutions are developed to improve residents' quality of life. Connectivity throughout the system provides virtually unlimited possibilities to develop applications for public benefit. According to Dr. Gonick, a number of startup companies have sprung up with the help of OneCommunity expertise and infrastructure. These include firms such as SnappSkin, which provides healthcare monitoring and social interaction opportunities for home-bound adults; and Intwine Connect, which provides connected energy, home security, and environmental monitoring solutions utilizing Internet-enabled sensor technology.

OneCommunity is in the process of creating a development "sandbox" — a full-city-block experimentation area where developers and entrepreneurs can test different sensor technologies on the OneCommunity network.

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"We love to encourage piloting and experimentation," Dr. Gonick said, suggesting that the best experiments and solutions are those that address specific community needs. "Hopefully, these are cross-segment projects, so that libraries and museums are applying for grant opportunities to work together, and so that healthcare organizations are working in creative ways with the neighborhood for the delivery of community-based health and the like."

## Solution

Dr. Gonick says OneCommunity started roughly 10 years ago as a collaboration between Case Western Reserve University and the City of Cleveland. The organization now services major healthcare institutions in the northeast region of the state, as well as school districts, other higher-education institutions, museums and libraries, government organizations, as well as private enterprises.

"Today, we have 2400 route miles of our community-owned nonprofit fiber," Dr. Gonick said. "There are over 700 organizations actually on the network. It's a $200 million community asset, all with next-generation connectivity. We provide a full spectrum of engineered services, but with more fiber assets than anyone else — especially anybody prepared to actually use them on an open network committed to shared rights of use. There are probably 25 anchor institutions in our community. Our county library is perhaps among the most innovative in the country. It not only delivers traditional library services, but also partners with the Museum of Art and the healthcare community in ways that really are formed by the same kind of logic — everyone leveraging the network to create new opportunities."

## Public/Private Collaboration

Dr. Gonick's vision includes working closely with the private sector to foster competitiveness and economic growth, and to ultimately transform the OneCommunity service area into a "smart region." Inclusion of both the public and private sectors makes OneCommunity an ideal test environment for researchers and entrepreneurs. "It's in that context that we have been looking to continue the commitment to work with real community challenges for advancing not just traditional tethered network access, but also mobile and sensor networks, telemetry networks, and other things that we now call the Internet of Things," he said.

OneCommunity's collaborative approach is unique in the world of connectivity. "Our business model is fundamentally about connecting public-benefit organizations, so we are very much a competitor to a lot of other kinds of network providers," Dr. Gonick explained. "But unlike all of them, we have a core mission that is about effectively improving the quality of life around key areas of community health and wellness, education, workforce training, and community and neighborhood safety."

"Our business model is fundamentally about connecting public-benefit organizations, so we are very much a competitor to a lot of other kinds of network providers. But unlike all of them, we have a core mission that is about effectively improving the quality of life ...."

## Education and Pilot Programs

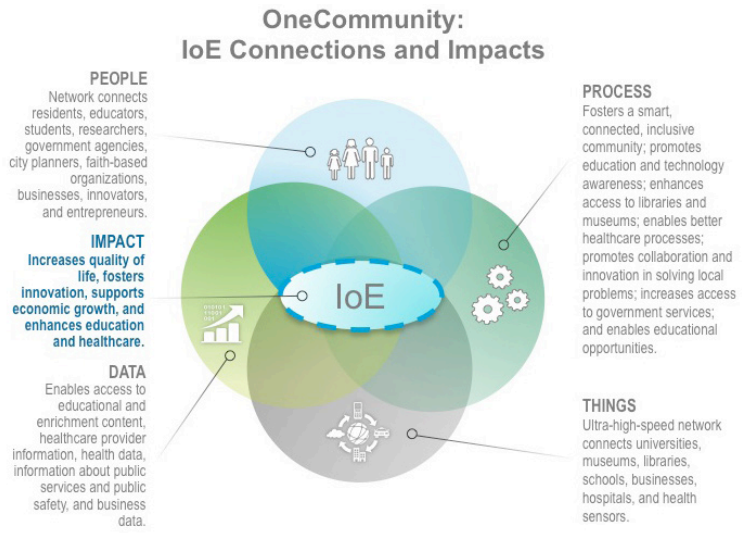
OneCommunity actively pilots many outreach and civic improvement programs, which have extended well beyond Ohio. For example, the Connect Your Community program encourages connectivity and learning by providing broadband training, low-cost equipment, support, and affordable Internet connectivity to low-income residents from Detroit, Michigan, throughout Appalachia, and as far south as Bradenton, Florida.

Dr. Gonick encourages a cooperative effort in identifying and addressing the "pain points" of each community in these programs. He describes the Connect Your Community program as one that is "following this model of piloting and finding the right delivery partners in the community. These could be public housing partners or faith-based organizations and the like. We'll then help them focus in on what they've identified as a serious pain point – we'd call it a business problem, but they're really community pain points. These issues may include inability to apply for jobs online because they don't know how to get online, or not knowing how to file their taxes."

Dr. Gonick highlighted one example where schools and medical institutions are partnering to increase education to combat the massive health challenge of type 2 diabetes. As part of the program, OneCommunity helped facilitate the use of immersive video-conferencing technology to enable students to connect their parents and family members with doctors and healthcare professionals for diabetes education and patient consultation. This interaction allowed healthcare professionals to reach medically underserved populations in the Cleveland area.

Figure 1. OneCommunity: New and Better Connections.




Source: Cisco Consulting Services, 2014

Benefits provided by OneCommunity's network include the organization's collaborative ability to drive technological solutions to specific community needs, and to respond quickly and flexibly from a local Network Operating Center, meeting best-in-class service-level agreements.

## Impact

Benefits provided by OneCommunity's network include the organization's collaborative ability to drive technological solutions to specific community needs, and to respond quickly and flexibly from a local Network Operating Center, meeting best-in-class service-level agreements. In addition, the model has spurred economic development around community-based solutions such as in-home healthcare monitoring and environmental monitoring.

### Collaborative Busines Model

Dr. Gonick believes some of the greatest advantages of his collaborative business model are its flexible approach and support of innovation. He emphasizes the importance of partnering closely with local entities for low-cost and creative solutions. "We're local, so we're responsive to local needs rather than the call center being somewhere in another state or offshore. We do a huge number of community 'convenings' around thought leadership, including conversations about how the community can think about the Internet of Things in ways that no other Internet service provider is likely to," he said.

### Economic Benefits

Dr. Gonick recognizes that ready access to state-of-the-art broadband is essential to any community seeking to attract businesses and support economic growth. He also wants to leverage that connectivity to make highest-speed network services accessible and affordable for all residents.

OneCommunity both competes against and partners with traditional broadband providers to creatively provide affordable access options to public institutions and disadvantaged residents, but Dr. Gonick also oversees a for-profit arm of the organization that works exclusively with private enterprise. "We think it could be

transformational for our region to focus in on ways in which the network can serve as a business and economic development attractor," he explained.

### Educational Opportunities

Increased access to educational opportunities is a primary objective for OneCommunity, which connects K-12 school districts, higher education, museums, and libraries within its service area. Additionally, OneCommunity sponsors free training and provides affordable equipment and services for the disadvantaged through its Connect Your Community and Connect to College Now programs. OneCommunity also supports libraries and museums in building online learning opportunities and providing cost-effective services.

In November and December 2012, OneCommunity conducted a random survey of 10,400 of its Connect Your Community participants. Among the results, 95 percent of respondents gave the programs a rating of "Good" or "Excellent," with 99 percent of respondents indicating they would recommend the program to others. Even more significantly, 22 percent of respondents indicated they had obtained new employment as a direct result of training provided by the Connect Your Community program.

In addition to connecting healthcare facilities and providers on its network, OneCommunity sponsors programs to make healthcare and government health service information more easily accessible to users.

### Health and Public Safety

Improved access to healthcare information and services is another benefit provided by OneCommunity. In addition to connecting healthcare facilities and providers on its network, OneCommunity sponsors programs to make healthcare and government health service information more easily accessible to users. In the survey mentioned above, 81 percent of respondents indicated the Connect Your Community program improved their ability to find health information online.

OneCommunity also provides broadband services to governmental agencies, and partners with local entities to increase the public's awareness of online services and health information. The organization also supports programs designed to monitor health concerns such as diabetes, and to track air quality and other environmental health concerns, such as lead content within neighborhoods.

## Lessons Learned / Next Steps

Dr. Gonick concedes that it can be challenging to organize the vast amounts of available data on large public-oriented networks – particularly as sensor-based technology develops – and then actually use that data to improve quality of life within a community. The challenge lies, he says, in "not only figuring out how to generate tons of data from sensors, but to think about an elegant model that allows us to know how to create a healthcare atlas for our community – for example, one that's not overwhelming the community with data, but really trying to help them."

The long-term goal of data collection and disbursement for the public's benefit guides Dr. Gonick's work. "I resist the temptation for a technical fit in favor of a more holistic orientation, which means it's a longer journey," he explained. Dr. Gonick partners closely with the community to accomplish these goals in unique and cost-effective ways.

"Because we're a production network, not an experiment, we definitely are a blend," explained Dr. Gonick. "We are absolutely a significant public benefit enterprise network provider, but the reason I'm having dinner with the CIO of the university healthcare system is because he wants to talk about innovation and the cost of the network access that he has with OneCommunity."

Going forward, OneCommunity is emphasizing a "city as an operating system" approach, encouraging further technology development through piloting and providing test-bed opportunities for local innovators and entrepreneurs. According to Dr. Gonick, some companies are actually moving to the Cleveland area to take advantage of the innovative network, bringing added economic development and capacity to the region.

Going forward, OneCommunity is emphasizing a "city as an operating system" approach, encouraging further technology development through piloting and providing test-bed opportunities for local innovators and entrepreneurs.

OneCommunity's engagement in pilot programs furthers its goal of establishing a smart and connected community. One example is a sensor-based program for the many residents in his community with type 2 diabetes. "I was out at a startup company in one of the neighborhood communities here, where I saw a fabulous new sensor technology solution for house-bound adults, many of whom are either obese or have diabetes that has become debilitating," Dr. Gonick explained. "Sensors are used to monitor their health and at the same time provide them with social interactions with their families and with others to keep their quality of life as high as possible." Other potential pilot initiatives include a telehealth program and kiosk-style healthcare consultations.

"We very much see the city as an operating system in a two- to five-year horizon," Dr. Gonick said. He believes his organization is nearing its goal of increasing the quality of life in northeast Ohio in a number of significant ways, and cites the environmental impact of monitoring lead content and air quality. Dr. Gonick is also planning programs to address the region's aging baby boomer generation, saying the organization is looking to roll out a connected and smarter aging strategy to improve quality of life across a number of areas broadly.

Dr. Gonick says that he will continue to work toward "extending network reach from the traditional idea of simply surfing the net, to being interactive and, we think, compelling, in addressing a community-identified challenge. We very much see ourselves as being catalysts for a reimagining and a reinvention project that is informed by how a community can use large digital infrastructure initiatives to help it come together to chart its future."

# IoE Capabilities Will Help Ontario Lottery and Gaming Create New Revenue Streams



## EXECUTIVE SUMMARY

### Objectives

- Expand shareholder profits, attract younger audience, and ensure that gaming dollars remain in province

### Strategy

- Modify operational abilities to reflect new oversight role and focus on analytics
- Within 12 to 18 months of releasing the online gaming platform, launch mobile gaming opportunities

### Solution

- PlayOLG.ca gambling and lottery website offers player protection, secure transactions, and data privacy
- Virtual wallet will allow gamers to collect wagers and make deductions for lottery play

### Impact

- Open new revenue streams by capturing segments of population not interested in traveling to physical gaming facilities
- Recover taxes and profit that are otherwise going to offshore online gaming companies
- Detect fraud and protect integrity of product more precisely than casino cameras allow
- Benefit public projects – such as infrastructure, education, and healthcare – with new facilities in municipalities
- Increase efficiency and oversight
- Utilize Responsible Gaming program more effectively through better information tracking

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

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The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

 

## About Ontario Lottery and Gaming

In order to expand shareholder profits, Ontario Lottery and Gaming (OLG) is modernizing the way it provides lottery and games. OLG is an important revenue source for the Ontario government, and as technology has developed, OLG leadership sees a need and opportunity in the growing public demand for iGames. In an effort to keep gaming dollars in the province, OLG is launching PlayOLG.ca, a new, secure website for gambling and lottery play. It will offer player protection, secure transactions, and data privacy, and will require players to register to play. The iGaming initiative at OLG is part of a larger modernization strategy aimed at utilizing technology to improve operations in Ontario's gaming industry.

Tom Marinelli is acting president and CEO of the Ontario Lottery and Gaming Corporation. He has been with OLG for 23 years. Previously, Mr. Marinelli served OLG in a number of other senior positions, including vice president, gaming support; vice president, corporate business optimization; and chief technology officer. Most recently, he held the positions of executive vice president, chief transformation officer, and chief information officer. He has a degree in systems design engineering from the University of Waterloo, and, prior to OLG, spent time in the industrial, military, and pharmaceutical sectors.

The agency realized an overhaul of product delivery, as well as operational management, was necessary. OLG saw that rather than expecting all customers to go to casinos or retail locations to purchase lottery tickets, the games should also be made available to customers online in a responsible manner. A plan was developed to introduce online gaming (followed by mobile gaming), as well as to transform the agency from an operational delivery organization into a strategy and market management agency.

## Objectives

After significant drops in casino attendance over the past decade, Ontario Lottery and Gaming evaluated what would draw more customers. The research indicated that adults under 45 bought lottery tickets less frequently than their older counterparts. The agency realized an overhaul of product delivery, as well as operational management, was necessary. OLG saw that rather than expecting all customers to go to casinos or retail locations to purchase lottery tickets, the games should also be made available to customers online in a responsible manner. A plan was developed to introduce online gaming (followed by mobile gaming), as well as to transform the agency from an operational delivery organization into a strategy and market management agency.

## Strategy

OLG is working with Internet and mobile gaming providers to launch an Internet gaming platform, PlayOLG.ca, in late 2014 to attract new customers. There is a procurement process to select vendors, with one vendor already creating a suite of games that will be part of the initial launch. Mr. Marinelli talks of the importance of connecting with new companies to reach demographics that are less interested in location-based casino gaming. "Are people under 45 really interested in buying a lottery ticket that's a piece of paper? Is there something else? Could they be more entertained? We're really trying to capture that ability," said Mr. Marinelli. "The other thing that we're finding is that the refresh of a game has to be quicker, so that is where we are building technology. I do think not only from Ontario Lottery and Gaming Corporation, but from a lottery and gaming vertical, we're looking at a step into the new world. We're not necessarily cannibalizing the existing channels – it's actually growing the whole pie."

 

Mr. Marinelli described how online gaming will improve the experience for both the customer and for OLG. "As Ontario Lottery and Gaming develops into the future," he said, "it is going to become more of an information-driven company than an operational type of organization. We're going to be using the information we gather from the Internet or lottery play, and eventually we want to get to what I call the '360' of the customer anywhere in the province. If you identify yourself, we are going to include you in the hub of all gaming information in Ontario. This will help with fraud detection, analytics, market management, and responsible gambling. We would have a direct connection with every customer to provide them better, more capable service." Because each customer will go through a number of screens to verify identity and age, issues like lost lottery tickets become a problem of the past.

According to Mr. Marinelli, the online platforms will allow OLG to detect fraud and protect the integrity of its product more precisely than cameras in casinos allow.

Being in the online and mobile gaming markets will help the province recover profits that are otherwise going to offshore online gaming companies. "We're getting cannibalized anyways – $400 million, right now, goes out of Ontario, offshore," Mr. Marinelli stated. "As a province, we're watching the money leave and we said to ourselves, 'O.K., $400 million – it's the Internet.' And now we have to provide a competitive site. We're not going to get all of the $400 million, but we want to be competitive. Let's say we get a quarter of that, or one-third of it. That's a significant amount of money that comes back to the people of Ontario. It's money that supports priorities like healthcare and education."

According to Mr. Marinelli, the online platforms will allow OLG to detect fraud and protect the integrity of its product more precisely than cameras in casinos allow. "We can collect every key click. You get a lot more information when you're online than you do if you're in a retail area or even on a slot machine. You can monitor everything, so it's just sifting through that pile of information to monitor for fraudulent behavior, responsible gambling, that sort of thing."

Ontario Lottery and Gaming will use a secure virtual wallet that enables games to collect wagers, and will also allow deduction for lottery play. According to Mr. Marinelli, it will connect to the same lottery engine that connects to retail lottery locations, but "the only difference is when you buy online, you get a nice customer service benefit because you will have self-identified and we have your name and address. If you win, you'll be able to transfer money from the site into your bank account. When you transfer funds into your virtual wallet to play, you know you're only allowed to do so much. That is where our Responsible Gambling Program comes in." The "wallet" will also be credited with any winnings a player might receive.

According to Mr. Marinelli, the larger modernization program will add to OLG's contribution to the Provincial Treasury – already the biggest source of nontax revenue for the government of Ontario. Actuals are not available because it is still in procurement and implementation stages, but Mr. Marinelli says, "We have said we will provide the province with approximately $1 billion in new revenue annually by the time we get to 2018."

The Ontario government owns and oversees activities and budgets related to Ontario Lottery and Gaming. Therefore, if there are changes to OLG's oversight, contracts with service providers, or how it delivers gaming, the Ministry of the

 

Attorney General must approve that it aligns with the Criminal Code of Canada and Gaming Control Act of Ontario.

Ontario Lottery and Gaming has a conduct and management role within the gaming industry, where gaming providers are private operators. OLG's role, however, allows the collection and dispersion of profits, along with enforcing compliance with proper gaming controls in the province. "Gaming in Canada started out where we had to do everything. As the world unfolds and technology starts to come, you have more ability to reach into the operations and you can kind of back up over who does what, [but we] still have to have management and control," Mr. Marinelli said.

In Sault Ste. Marie, Ontario, OLG has partnered with the Innovation Centre to have developers come up with new games that may be of interest to OLG customers. Characterizing the Innovation Centre as a "petri dish" of software innovation, Mr. Marinelli says the ideas coming out of the Centre have been truly impressive, such as a game that incorporates elements of both bingo and Tetris.

Ontario Lottery and Gaming does extensive public outreach through its Media, Communications, Government, and Stakeholder Relations group. This includes a website: www.ModernOLG.ca. The public relations campaign goes beyond the gaming customers, also reaching the retail and gaming operators as well as municipalities and First Nations, vendors, and the general public. In part, this is to broaden understanding about the project and how it might affect operator income, as municipalities and First Nations that host gaming facilities receive a portion of the profits.

## Solution

Online casino-style games have traditionally been developed by large gaming companies such as Bally and International Game Technology (IGT). However, Mr. Marinelli says that HTML5 opens more opportunities for sourcing games from other companies that might offer different ideas. "I think the world is going to fundamentally shift," he said. "If we have specifications that we want to make sure the game has integrity, we can open it up to the world and say, 'Come up with games that meet these standards,' and then things will open up. It will allow the smaller companies and maybe the garage guys to bring it forward. Then you are going to get the games and ideas coming faster." All games will have to meet the regulator's standards for integrity.

In Sault Ste. Marie, OLG has partnered with the Innovation Centre to have developers come up with new games that may be of interest to OLG customers. Characterizing the Innovation Centre as a "petri dish" of software innovation, Mr. Marinelli says the ideas coming out of the Centre have been truly impressive, such as a game that incorporates elements of both bingo and Tetris. Innovation Centre products tend to be more community-based, competitive, and attractive to adults under 45, while also keeping baby boomers interested.

Ontario Lottery and Gaming is developing a virtual wallet that will be linked to bank accounts so customers will be able to transfer money directly to their virtual wallets. Customers will also be able to set strict amounts that can be withdrawn in a certain timeframe to help enforce personal responsibility and responsible gambling.

 

"OLG, through all of this, has taken the position that we want to be the gold standard in responsible gambling. We're going to use technology to help us with that."

Tom Marinelli,
Acting President and CEO,
Ontario Lottery and Gaming Corporation

**Figure 1.** Ontario Lottery and Gaming: New and Better Connections.


Source: Cisco Consulting Services, 2014

## Impact

In addition to increased efficiency and customer and market management for OLG, the modernization and information tracking will allow OLG to more effectively utilize its Responsible Gambling program. "We have to provide lottery and gaming responsibly. So as you get more points of contact to do gambling, you have to be more and more attuned to responsible gambling," Mr. Marinelli stated. "You have to be aware of how people are gambling and help them manage their own risks. And then you have to provide the ability for them to set limits and look at their own behaviors. What that does, particularly in the I-space, is actually start to increase the demand for analytics and back-end information technology. OLG, through all of this, has taken the position that we want to be a gold standard in responsible gambling. We're going to use technology to help us with that."

The customer-facing aspect of modernization is to release gaming platforms on the Internet. This will capture segments of the population not interested in traveling to physical gaming facilities, thus opening new revenue streams for OLG. This will be followed by a rollout of mobile app games, which OLG believes will reach even more people. "The first thing out the gate is to do casino-style games," said Mr. Marinelli. "We will also sell lottery products on the Internet through an OLG portal. Basically, you come online and then that's really the start of a phase of offering different products: poker, bingo, and other things down the road, and also tied to that, soon afterward, mobile. It's really getting the Ontario Lottery and Gaming Corporation out into the Internet space to sell products that we [already] sell on the more traditional channels." OLG will deliver interfaces that clearly define it as an OLG brand, along with access to the Responsible Gambling program run by the agency.

 

"The mobile is moving so quickly, we want to make sure that we get there. It's not just gaming; it's all about where people are getting their entertainment right now. You want to be relevant to them and where they are getting their entertainment."

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Acting President and CEO,
Ontario Lottery and Gaming Corporation

## Lessons Learned / Next Steps

According to Mr. Marinelli, clarity of vision and leadership are essential to the success of an organization-wide technological transformation. "Stability at the top of the organization is critical as you go through," he said. "We just had a change of president and CEO, and actually our board. The government is still committed, but at the end day, having consistent leadership over the length of time you're doing this is invaluable."

Another lesson learned by Ontario Lottery and Gaming, Mr. Marinelli said, is "don't underestimate the enablement of technology. The technology roadmap actually has input into the business model, on how you roll it out. When you stand up parts of the organization, either the technology has to be there, or you are going to have more people to actually deal with the information that's coming in, [which is] very complicated."

Ontario Lottery and Gaming will continue to modify its operational abilities to focus on game development, programming, and analytics. Within 12 to 18 months of releasing the online gaming platform, OLG will launch mobile gaming opportunities. "The mobile is moving so quickly, we want to make sure that we get there. It's not just gaming; it's all about where people are getting their entertainment right now. You want to be relevant to them and where they are getting their entertainment."

## More Information

For more information, visit http://www.ModernOLG.ca or http://www.PlayOLG.ca

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# IoE-Driven Capabilties Help OTN Reduce Travel and Hospitalizations – and Improve Patient Care

## EXECUTIVE SUMMARY

### Objectives

- Help the medical community integrate telemedicine into everything they do
- Deliver better care and value

### Strategy

- Provide a technological and organizational structure that supports and maintains telemedicine capabilities throughout the province of Ontario, Canada

### Solution

- OTN provides tools that allow healthcare organizations to easily communicate with one another
- Physicians and other healthcare providers use the network for conferencing, clinical collaboration, and to gain access to education
- OTN's services fall into five areas: Health Care Office, E-Consult, Emergency Telemedicine, Learning, and Telehomecare

### Impact

- OTN facilitates more than 300,000 clinical encounters and more than 40,000 educational and administrative events annually
- Telemedicine helped Ontarians avoid more than 259 million kilometers (more than 161 million miles) of travel in the last year
- Telehomecare has drastically reduced hospitalizations among chronic care patients enrolled in the program – a 60 percent reduction in the pilot program and early results of 71 percent in the expansion program

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

 

## About the Ontario Telemedicine Network

The Ontario Telemedicine Network (OTN) is one of the largest – if not the largest – telemedicine networks in the world. OTN focuses on delivering tools that incorporate telemedicine into mainstream practices.

With more than 1,300 collaborating organizations, including hospitals, clinics and research and academic institutions, OTN provides a technological and organizational structure that supports and maintains telemedicine capabilities throughout the province of Ontario, Canada. In terms of scale, OTN provides more than 300,000 clinical encounters and 40,000 educational and administrative events each year.

Dr. Edward Brown is a founder and chief executive officer of OTN. Dr. Brown has won numerous awards for his work, including a Queen Elizabeth II Diamond Jubilee Award for his contributions to healthcare in Canada. He serves on several boards and is the president of the American Telemedicine Association.

Frank van Heeswyk is chief technical officer and vice president of technical services for Ontario Telemedicine Network. An experienced systems and development engineer, he worked for a number of technology companies in Canada, including stints as vice president of product development for Taqua, and as vice president of engineering for SOMA Networks, prior to joining OTN in 2012.

## Objectives

Seeking a way to bridge the sometimes vast distances separating physicians, specialists, and patients in rural Canada, Dr. Brown founded the NORTH Network in the early 1990s.

"Basically, in those days, telemedicine was hardware-based video-conferencing platforms via dial-up or, subsequently, private networks that linked them all together around the province," Dr. Brown said.

Services provided by the network have expanded since the original teleconferencing solution, powered by advances in technology, monitoring, and the development of new clinical approaches such as self-management coaching for at-home patients.

"We've gone through an Internet revolution, and it's finally happening in healthcare. We still use hardware video-conferencing units, and they are still valuable things you can roll around in a hospital, for example, but we've added much lower-cost software video conferencing. Everybody understands IP video-conferencing software now. It's standard on your iPhone or on your Android. We've added that and integrated it into the network," Dr. Brown explained.

According to Dr. Brown, his primary goal is to assist the provider community in integrating telemedicine into everything they do.

"We're trying to support the medical community to really think about ways to leverage this technology. There are two reasons to do that," he said. "One is to provide better care for patients. The second is to provide better value for money. In a sense, we have become telemedicine consultants to help support organizations to do both."

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## Strategy

In 2006, Dr. Brown's NORTH network merged with two other telemedicine networks to create the Ontario Telemedicine Network.

"We spent a few years integrating and developing a set of key services to support providers." Dr. Brown said. The results can be found on OTN's one-stop website, which provides secure access to OTN's services. Among its many links, patients can learn more about Telehomecare, providers can consult with one another, healthcare organizations can schedule events, and teleconferences can be scheduled.

Thanks in part to an active marketing and communications campaign to create awareness in the healthcare sector, growth at OTN has been remarkable. More than 300,000 clinical events took place last year – a 33 percent increase compared to the previous year. An independent, not-for-profit organization, OTN is primarily funded by the Government of Ontario. Additional revenue comes from the membership fees of non-ministry of health providers and from additional fees for installations of telemedicine systems and various premium services offered.

OTN provides tools that allow healthcare providers to easily communicate with one another and with their patients.

## Solution

OTN provides tools that allow healthcare providers to easily communicate with one another and with their patients. Providers use the network to deliver care through video conferencing with patients. Providers also share data asynchronously among themselves to deliver clinical care for their patients. They also use multipoint video conferencing, web conferencing, and webcasting technologies to support educational events or meetings over a distance.

"The first and probably the most important service we provide is harmonized collaboration," Dr. Brown said. OTN's collaboration agreement with its members requires standardization across the various members' systems and processes to allow easy communication with one another, including one set of technical standards and a privacy and security overlay. OTN support staff is available to assist members with business process support, technical support, and training. "We provide that core governance structure and the core business process that everybody needs to work with each other," he said.

OTN maintains two large data centers within the provincial infrastructure that host centralized services and applications, as well as manage network data traffic. OTN members use OTN's virtual private network to communicate via video-conference appointments and sharing. OTN also provides software interfaces that deliver their various services, such as video-conference appointment scheduling and consulting and technology support services to keep members' systems up and running.

OTN's video-bridging system includes dynamic transcoding and speed matching to allow different video-conferencing systems to communicate with the highest possible video quality. The system also operates an IP gateway as well as a centralized pool of ISDN circuits that non-members can use to connect with the system using compatible video-conferencing systems.

 

Video content between physicians and their patients is private and secure; it is not stored, but "disappears into the ether" following the video conference, according to Chief Technical Officer Frank van Heeswyk. According to Dr. Brown, in the vast majority of cases, individual healthcare organizations own the technology that connects them to OTN's network. This includes the computers, monitors, cameras, and even specialized monitoring equipment such as digital stethoscopes and otoscopes. OTN will assist in providing recommendations when organizations procure these items to help ensure they are compatible with the network, but OTN does not own the equipment itself.

## Healthcare Office

Dr. Brown describes Health Care Office as "traditional telemedicine." For physician/patient encounters, OTN's Health Care Office replaces traditional doctor's examinations with the use of video conferencing and telediagnostic instruments like digital stethoscopes, handheld exam cameras, and digital otoscopes. The patient typically travels to a local rural health center or clinic for access to both the medical and conferencing equipment. "Basically, it's like a visit in the office, except the patient and the doctor are a thousand miles away from each other," said Dr. Brown. "Last year we facilitated about 300,000 events of this nature." A telemedicine coordinator – in the same location as the patient – assists physicians in managing examinations and consultations.

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Mr. van Heeswyk emphasizes that during physician/patient interactions, measurements from biometric sensors such as stethoscopes and handheld cameras are reviewed by the physician in real time. OTN's primary role in these encounters is facilitating the collection of patient data, much as data would be collected if the patient were examined in the physician's office. "OTN is all about facilitating the patient/provider interaction through virtual means," he said.

## E-Consult

E-Consult is an asynchronous service used in cases where a provider needs a specialist opinion but the diagnosis and management plan can likely be provided by the referring provider. There's no direct interaction between the patient and the specialist. For example, digital images and the patient's history, collected by a primary care physician, are sent to a specialist located hundreds or thousands of miles away. That specialist then diagnoses and provides treatment advice based on the digital information. The specialist typically does not see the patient directly, and all patient interaction is managed through a primary care physician.

"It's pretty straightforward," Dr. Brown said. "You have a funny-looking mole or a rash. Your primary care provider takes a picture, adds your history and sends it electronically to the dermatologist, who reviews it at a convenient time and sends back a management plan and advice."

These various asynchronous technologies greatly extend reach of specialists to people living in areas without specialists.. Examples of specialties where E-Consult has been highly utilized include dermatology and ophthalmology. The service is growing in wound management and even in psychiatry.

 

"In areas where there are not as many psychiatrists – in rural areas, for example – a health professional will video-record a standard interview and send it along to a psychiatrist to review and provide advice."

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"In areas where there are not as many psychiatrists – in rural areas, for example – a health professional will video-record a standard interview and send it along to a psychiatrist to review and provide advice," Dr. Brown explained. "E-consult will be soon be used in every specialty because it enables healthcare providers to collaborate more effectively and deliver better patient care."

## Emergency Telemedicine

Emergency telemedicine provides rapid access to specialized resources whenever and wherever they are needed. This service includes emergency telestroke care, burn care, trauma care, mental health crisis support and tele-ICU care. In many of these cases, there is an urgent need for specialist knowledge and insight. By providing an emergency telemedicine service, OTN has greatly expanded the medical capabilities of rural clinics and small hospitals, linking them with larger trauma centers and other centers of expertise.

## Learning

Learning leverages OTN's network to provide cost-effective professional education opportunities or administrative events such as group and/or one-to-one meetings. OTN offers fully integrated conferencing solutions, including video conferencing, webcasting, and webconferencing.

By enabling cost-effective dissemination of health education and best practices, OTN enhances access to the collective intelligence of healthcare providers across the province and reduces travel costs. More than a quarter-million people per year participate in OTN-facilitated education events.

## Telehomecare

Telehomecare is OTN's newest program, delivering weekday monitoring and weekly self-management coaching to chronic disease patients in their own homes. Currently implemented for patients with Chronic Obstructive Pulmonary Disease (COPD) and Chronic Heart Failure (CHF), the program includes daily monitoring of biometric statistics, providing a live feed to a specially trained nurse or respiratory therapist. A pilot is currently studying the applicability of Telehomecare for persons with diabetes.

According to Dr. Brown, in the healthcare systems of most developed countries, about 5 percent of the population uses 60 to 80 percent of healthcare resources. Patients with chronic disease represent the largest part of the 5 percent. "Tele-homecare targets COPD and CHF because there's a large behavior management component to controlling those diseases. If we can actually improve patients' understanding of their disease, if we can help them manage it better, we can keep them healthier, keep them alive longer, and keep them out of the hospital. And that substantially reduces the pressure on healthcare resources," Dr. Brown said.

Telehomecare requires weekday self-monitoring of biometrics by the patient. Nurses monitor the data and provide feedback, coaching the patient in healthy behaviors and intervening or alerting a physician when problems appear.

 

The medical devices used by the patient are either Bluetooth and connected to a mobile device or are plugged into a tablet's USB connection. The data is normally transmitted directly without intervention by the patient. "Patients use a touchscreen tablet to answer questions about how they are feeling and a set of devices to measure their oxygen levels, sometimes their weight, and their blood pressure," said Dr. Brown.

"It's all automated," Dr. Brown added. "We don't like the idea of patients typing in data – they make mistakes. And, sometimes, they don't like to tell you how much weight they gained. It's all machine-to-machine. The connectivity depends on what they have in their home." In most cases, patient-monitoring equipment connects to OTN servers via the patient's in-home Internet connection.

"These diseases require education and behavioral changes. These are process-oriented changes that we just haven't been able to implement as a system because we haven't been able to reach out to the patient in their home. We haven't been able to give them what they need to be successful. This is really addressing what I believe is the core challenge that we have: how to keep these folks healthier and out of the hospital."

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Mr. van Heeswyk points out the importance of maintaining ease of use in designing digital medical peripherals for patient use. "They can be as simple as a scale where they measure their weight. It can be a pulse oximeter. It can be a blood pressure cuff. Almost any device can be hooked into the system.

"The nurse or respiratory therapist responds to numbers that are outside the norms for that patient," he added. "They can connect with the patient's doctor to make a change in medication or, in some cases, use the opportunity to coach the patient. It helps prevent the patient from getting sicker."

As Dr. Brown explained, "One day, a patient will get a call from the nurse, who has noticed that they're gaining weight and their oxygen level is dropping. The patient will pick up the phone and say, 'I knew you'd call. I had a big fish and chips meal last night with a lot of salt.' So patients begin to really understand that how their behavior changes their lives.

"It doesn't sound like much, but if you're a patient with heart failure and you start to collect fluid because of your diet, you gain a pound in weight and that fluid ends up in your lungs. You end up short of breath, you call 911. You're in the intensive care unit with a breathing tube for two weeks before they can get you home, if they can get you home at all. When you're able to help a patient avoid that behavior that causes fluid retention, you're making a patient a lot healthier and you're saving the health system money.

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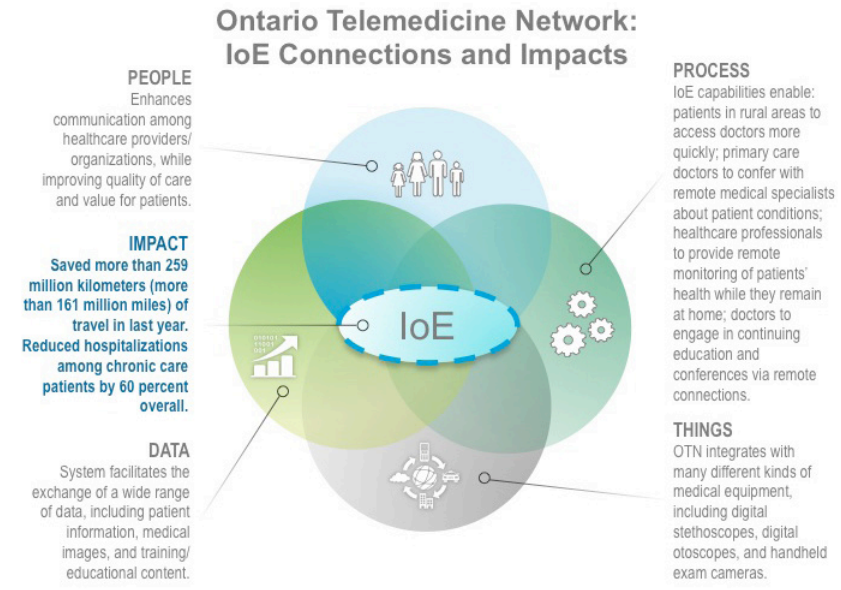
Figure 1. Ontario Telemedicine Network: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

According to Dr. Brown, the benefits of telemedicine and the OTN network are profound. The ability to provide services in rural areas and to improve access to specialists and other healthcare providers has changed healthcare. Last year, OTN provided access to nearly every medical and allied health specialty, and was used in more than 300,000 clinical encounters and more than 40,000 educational and administrative events.

Because care is delivered in or near the patient's home, it avoids costly travel and results in quicker patient engagement. "Telemedicine saved more than 237 million kilometers of travel in the last year alone – that's a greater distance than 300 trips to the moon and back," Dr. Brown explained.

In addition, quicker access to specialty consultations results in faster diagnoses and more coordinated treatment plans, and access to immediate emergency consultations can even save lives in acute care situations.

Daily in-home monitoring in the Telehomecare pilot is translating to better patient self-management, leading to drastically reduced hospitalizations among chronic care patients – a 65 percent decrease in the pilot program, and early results of a 71 percent decrease in the expansion program.

Through self-monitoring and regular health coaching, patients become more aware of the significance of gained weight, higher blood pressure, or other changes in the numbers. They begin to understand how their behaviors drive their conditions. "Telehomecare is extraordinarily powerful," said Dr. Brown. "In fact, it's probably the

most powerful thing I've seen to help patients understand their illness and change their behavior."

## Lessons Learned / Next Steps

"Massive changes in technology have revolutionized telemedicine," Dr. Brown said. "We have much more ubiquitous connectivity – everybody is connected. We have exciting activity in the space to develop new applications that are software-based, new sensors, and, probably most important, we have a newfound understanding and awareness of the power of the connected Internet. Healthcare providers now understand and are excited by this new world."

OTN is about to launch a new platform to promote collaboration that will make access easier and enable new developments in E-Consult, Telehomecare, and direct-to-patient services. "We're going to give everybody one place to go for all of their collaborative and telemedicine services. Single sign-on, the ability to find each other and the resources they need, ability to organize it, and the ability to actually do it. And we're going to build it so that it's integrated with all the rest of the e-health infrastructure that we have in Ontario."

"Your physician is going to tell you to take two apps and call her in the morning."

Dr. Edward Brown,
Founder and Chief Executive Officer,
Ontario Telemedicine Network

The Ontario Telemedicine Network is at the forefront of the rise of telemedicine as a mainstream channel for healthcare delivery and Dr. Brown is excited about the future, predicting that genomics and nanotechnologies will have a profound impact on the industry.

"There's a revolution underway in terms of devices and sensors that will live at the patient side of the equation," he explained. "There's amazing stuff out there that will read your blood sugar, transmit your heart rate, check your blood pressure, whatever it is. There's really incredible technology, and it's already out there and already approved. It's not science fiction – it's already being used." As technology becomes more widely available and more reasonably priced, Dr. Brown sees more change. "We are just beginning to see the next wave of innovation and entrepreneurship," he said.

Mr. van Heeswyk sees growth in the future as trending away from video conferencing on dedicated systems and moving toward personal devices, apps, and other technologies compatible with mobile devices. "I think the legacy [video conferencing] systems are not going to grow much. I think they will always be around, but I think the major growth in the future will be around access via personal devices over the Internet," he said.

Dr. Brown's vision of the future is one in which patients take an increasingly active role in their own health and are more comfortable with conducting their own biometric testing, becoming more personally vested in the results. "Your physician is going to tell you to take two apps and call her in the morning."

Dr. Brown adds that the savings and convenience of telemedicine are secondary priorities to increasing access to high-quality health care. “It’s about how you are going to use this technology, how you are going to create the processes and support that will make this meaningful for your patients, for your providers, for your organization. Technology is the enabler – it allows you to think about how you’re going to make things better.”

## More Information

For more information, visit http://www.otn.ca

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# IoE-Based Rio Operations Center Improves Safety, Traffic Flow, Emergency Response Capabilities



**EXECUTIVE SUMMARY**

### Objective

- Improve safety and incident response
- Coordinate/integrate operations of multiple agencies

### Strategy

- 1) Collect information from sensors such as rain gauges, radar sensors, bus GPS systems, images, social networks, and other sources; 2) analyze information to make operational decisions; 3) disseminate information to the population, alerting citizens of disasters or other problems

### Solution

- Rio Operations Center integrates information from multiple government agencies and private sources to improve city safety and incident response
- Center uses social media, news outlets, and sirens to give emergency instructions. Also provides routine information services such as traffic flow and vehicle accident information, as well as updated commuter wait times.

### Impact

- More than 50 city agencies connected, with integration of agencies' pertinent data. Result: more cooperative and efficient relationships among city agencies.
- Faster dissemination of traffic and transit information to commuters, buses, and taxis. Result: smoother traffic flow and better travel experience for commuters and users of public transportation.

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About the Rio Operations Center

Establishment of the Rio Operations Center grew out of catastrophic flooding and landslides that occurred in Rio de Janeiro, Brazil, in 2010. The Center's job is to integrate information from multiple government agencies and private sources to improve city safety and incident response. Incidents that it manages range from public utility problems and public transit issues to emergencies and disasters. It also acts as an operational hub for coordinating safety and security at large events, such as Carnival, the 2014 World Cup, and the upcoming 2016 Summer Olympics.

Connecting agencies centrally allows Rio to coordinate communications and actions to events that affect the public. It uses social media, news outlets, and sirens located throughout the city to give emergency instructions. It also provides routine information services such as traffic flow and vehicle accident information, as well as updated commuter wait times.

Alexandre Cardeman is executive director for the Technology Department at the Centro de Operações Rio (Rio Operations Center). Previously, Mr. Cardeman was vice president at IPLANRIO. He has 32 years of experience in the public sector, working as a coordinator for the Pan-American Games and for the Brazilian Olympic Committee. He earned a master's degree in computing networks and another master's in public policy.

Thompson L. Pacheco is an IT manager for IPLANRIO, the city-owned IT company that works in association with the Rio Operations Center.

Begun in 2010, the initiative is based on three pillars: 1) collection of information from sensors such as rain gauges, radar sensors, bus GPS systems, images, social networks, and other sources; 2) analysis of information to make operational decisions; and 3) dissemination of information to the population, alerting citizens of diasters and other problems.

## Objectives

Following the floods, landslides, and avalanches that caused the deaths of more than 300 people in 2010, Rio Mayor Eduardo Paes decided that the city needed a center of operations to coordinate efforts to improve city safety and incident response. "He wanted to create a center where several agents would be present, and their efforts would be coordinated in a unified and integrated way," Mr. Cardeman explained. "This required connections to bring data from the outside sensors into the operations center, and it also required that information be sent from the center to reach the population."

Begun in 2010, the initiative is based on three pillars: 1) collection of information from sensors such as rain gauges, radar sensors, bus GPS systems, images, social networks, and other sources; 2) analysis of information to make operational decisions; and 3) dissemination of information to the population, alerting citizens of disasters or other problems.

The mayor asked that the Center be completed in advance of 2014 World Cup, so that it could be used during that event as well as the upcoming 2016 Olympic Games.

Rio Operations Center developed an "information architecture" by gathering existing information – both from the private and the public sectors – that was relevant to crisis and risk management. This information included databases, images, transit

mapping, transformer locations from electric power providers, and information from providers of special roads, the metro, and buses. “There was information about different events scattered in different offices,” Mr. Cardeman explained. “When we started ... there was the metro system, businesses, the railway, all the concessions that provide public service in Rio, and they all started sending information. But they were all isolated from each other. When we started the Center three years ago, we had about 20-30 layers, and today we have more than 250.”

Since its inception, the Center has managed events such as World Youth Day, Military Games, Rock in Rio, Carnival, and planning for the World Cup. “It is constantly being updated because every day new information comes: new needs, new sources, new ways to disseminate the information to social networks, TV, SMS, Otape, new technologies, and so on,” said Mr. Cardeman. “There will always be the need to adjust to these new technologies, to seek innovation, and to remain up to date.”

This media and Operations Center outreach means that citizens of Rio de Janeiro can see the direct, day-to-day impact of the Center on their own lives, both from an emergency response perspective and as a tool to aid travel within the city.

## Strategy

The Rio Operations Center has a mission to keep the citizenry informed at all times – 24 hours a day, 7 days a week. Radio stations transmit directly from the Center, and the Center has a Twitter handle to disseminate pertinent incident information in real time. Citizens can also Tweet requests for information from the Center. All final information is made publicly available. This media and Operations Center outreach means that citizens of Rio de Janeiro can see the direct, day-to-day impact of the Center on their own lives, both from an emergency response perspective and as a tool to aid travel within the city.

The city of Rio de Janeiro manages the Rio Operations Center, while the Center itself is responsible for day-to-day operations and coordination with city and state agencies. IPLANRIO is a technology company owned by the city that provides IT to all government agencies.

Rio de Janeiro’s city government funded the Rio Operations Center. The assets are now owned by the Operations Center, under control of the city government’s executive branch.

Most of the public relations for the Rio Operations Center developed organically, due to the press’s curiosity about the Center. After a Brazilian television network did stories on the Center, national radio and foreign press gained interest, and Mr. Cardeman says they “left with a good impression and started spreading the news. The exposure increased during these three years to where we are now.”

According to Mr. Pacheco, “The Center turned into a meeting point for the media .... It resulted from the interest of the media in the information we have available. So all the media – the press, social media, TV, radio, and so forth – started meeting at the Operations Center. All this resulted in publicity without any previous planning.”

## Solution

The Operations Center collects layers of data from multiple sources to monitor events in the city. Sources of incoming data include security cameras, water and rain gauges, private maps, traffic signal data, the electricity grid, traffic controls, public transit vehicles, and social media feeds such as Twitter and Waze. The Center employs more than 400 staff, and operates 24 hours a day, 7 days a week.

To date, there are about 600 cameras installed throughout the city. Some are connected through fiber-optic cables, while about 200 deliver images wirelessly. More than 10,000 collective and municipal vehicles are monitored by GPS.

"We also have a network of rain gauges, scattered all over the city, that send information to the Center through a telemetry system. We have mapped landslide areas – that is, populated places that are at risk for landslides – so there is a relationship between the level of rainfall in millimeters and the risks. So, we have rain gauges and sirens that are triggered from the Operations Center to alert the population to leave their homes and go to already-mapped secure places."

Alexandre Cardeman,
Exective Director, Technology Department,
Rio Operations Center

The Rio Operations Center itself has 80 screens that display data in real time. The Center uses a system called Geo Portal, a geo-referenced system that helps map the various data sources collected by the Center. Geo Portal also allows the Center to aggregate and view information from different city areas in new ways. There are currently 250 different layers that can be used.

"It is a large information panel with a Google map, and all these assets and objects are already mapped," said Mr. Cardeman. "When you are able to map layers, you can better understand the situation in an incident area. This allows you to make strategic decisions, to coordinate, to make operational plans, contingency plans, and risk analysis, with the observed area in mind."

To prepare for rain- and water-based natural disasters, sensors or cameras at key waterways monitor water levels. "When it rains, we find the balance between the level of rainfall and the water level of the rivers," Mr. Cardeman explained. "There are some critical places in the city where we installed cameras with a visual gauge that monitors how many meters the water will rise from the road and what roads need to be open or closed so people can circulate." Data from the sensors is transmitted through a 3G network.

"We also have a network of rain gauges, scattered all over the city, that send information to the Center through a telemetry system," said Mr. Cardeman. "We have mapped landslide areas – that is, populated places that are at risk for landslides – so there is a relationship between the level of rainfall in millimeters and the risks. So, we have rain gauges and sirens that are triggered from the Operations Center to alert the population to leave their homes and go to already-mapped secure places." The sirens alert affected communities of emergency situations, which are determined by a layered map showing risk levels by area.

Buses, taxis, and metro rail are equipped with GPS sensors that allow the Operations Center to monitor movements and locations. If a problem occurs in a metro station, the Center can locate taxis and buses available to compensate for the metro stoppage. The city is planning on constructing its own network for telemetry traffic control, in addition to radio communication.

Other information layers include location information on schools, hospitals, and police station locations.

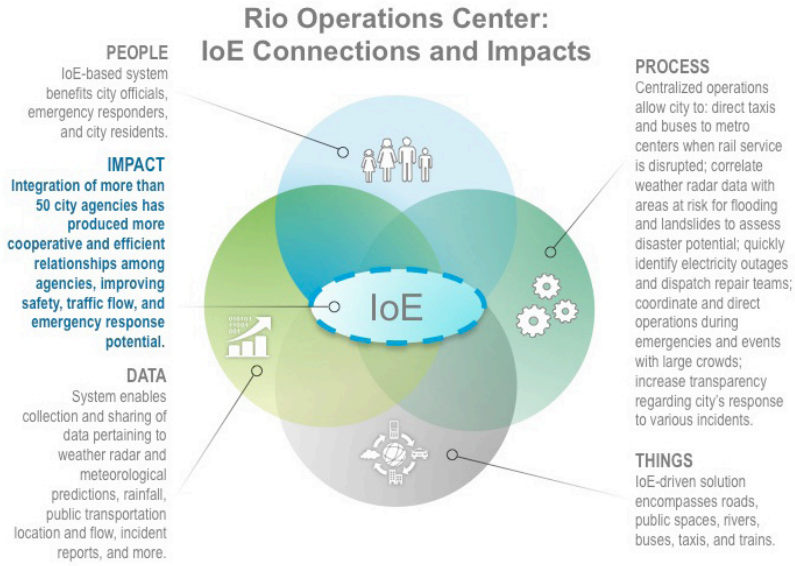
 

Rio has three telepresence systems, which have been used during crisis management situations. One telepresence system is installed in the Operations Center and two are installed externally – one for the municipal civil defense secretary, and one in the mayor's personal residence.

Rio Operations Center uses a LAN network in the building, both cabled and wireless, along with a "coy" and a 4507 Distribution Switch with five segments of 10 gigabytes. The data processing is handled at IPLANRIO's data center, which has a 20-gigabyte fiber-optic connection.

More than 50 city agencies have been connected, and pertinent data from the agencies integrated, due to the Operations Center. This allows more cooperative and efficient relationships among city agencies.

**Figure 1.** Rio: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

More than 50 city agencies have been connected, and pertinent data from the agencies integrated, due to the Operations Center. This allows more cooperative and efficient relationships among city agencies. The Center has also connected the city to commuters in new ways. Because of the center's relationship with the press, traffic and transit information can be disseminated quickly. Commuters can also access real-time updates via social media, and the city can respond to metro train delays by alerting buses and taxis in affected areas to converge on locations to pick up commuters.

"Citizens today have access to accurate information of what is happening in the city," Mr. Pacheco said. "It could be a simple traffic accident or a catastrophe, and the evolution of all this is what really matters." An unintended benefit is that the center has also connected media outlets to the city government, creating transparency and an ease of releasing information. "It is interesting that the Rio Operations Center also turned into a media or journalism center because all the information that reaches the Center. We see it as information to the public. There is

a study about what takes place at the Center, like print journalism, social media, TV and radio .... These journalists are very important in disseminating the information."

## Lessons Learned / Next Steps

Implementation of the Rio Operations Center was a lesson in patience. "You need to develop an internal policy to obtain data and information, and that doesn't come right away," said Mr. Cardeman. "Things don't happen in the short term, but over time through maturity, processes, and achievements .... It took us three years to get here." He says obstacles from dealing with government agencies, information, and masses of data require careful planning. It is integral to have an up-front agreement about duties and how agencies will perform. "You need to define a responsibility matrix because when you combine all of the agencies, everything needs to be transparent. Otherwise, you will be dealing with conflicts the whole time – management and/or responsibility conflicts."

"You need to develop an internal policy to obtain data and information, and that doesn't come right away. Things don't happen in the short term, but over time through maturity, processes, and achievements .... It took us three years to get here."

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Exective Director, Technology Department,
Rio Operations Center

The support of the executive branch was vital for Rio Operations Center. This top-down effort allowed proper oversight and diligence to ensure project support and completion. "Our mayor ... had meetings almost every day, wanting to know every detail about the Operations Center," said Mr. Cardeman.

Mr. Pacheco says the executive branch must be aware that considerable investment is necessary to properly complete the project. "The lack of an investment plan – not only the initial investment at the inauguration, [but a] plan to update technology and processes – might result in the loss of the initial investment."

Rio Operations Center is in the midst of gathering performance indicators to pinpoint what is succeeding and what can be improved. In addition, the Center recently hired business intelligence analysts to study city behavior in hopes of making improvements in that field. The Center is working on city and environmental management plans, and wants to partner with NASA to exchange information about climate change. "We want to grow our base of analysis," Mr. Cardeman said. "We are creating development research, trying a partnership with Google using Google Glass on the streets."

Rio Operations Center is also creating an open-data policy, so that all information of benefit will be available to the population for personal or commercial use (such as application developers). For this project, layers of APIs and data dictionaries are being used so that information can be easily searched.

## More Information

For more information, visit http://www.rio.rj.gov.br/web/corio

 

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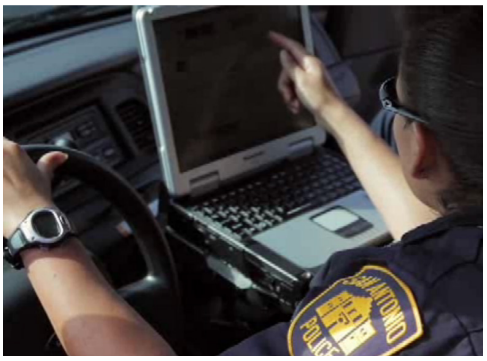
# IoE-Based Services Help San Antonio Cut Costs, Boost Revenue, Increase Safety, and Stretch Resources



**EXECUTIVE SUMMARY**

### Objective

- Use technology to deliver city services more efficiently

### Strategy

- Leverage city's fiber-optic network backbone to offer a broad range of programs for citizens and municipal workers

### Solutions

- Networked traffic light control system
- Remote, video-conference-based (telepresence) municipal court program
- In-car video and transaction technologies for law enforcement officers
- Sensor-based smart streetlighting

### Impact

- Prior to synchronization of traffic lights, an estimated $2 billion was lost due to longer commutes, higher fuel expenses, safety issues, and other factors
- Remote court system drives more efficient delivery of judicial resources and city services, while also freeing up parking, shortening wait times, and stretching judicial resources
- Integration of technology into law enforcement vehicles has dramatically reduced the administrative burden on police officers
- Smart streetlights have increased safety while conserving energy and public funds

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases — how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions — federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) — to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About the San Antonio Smart City Project

San Antonio, Texas, the seventh-largest city in the United States, is a leader in the implementation of Smart City technology. Current programs include an advanced synchronized traffic light program and a live video system for remote court hearings. San Antonio is currently expanding a sensor-based LED streetlighting system and planning a citywide smart parking initiative.

Underlying this progress is the installation of miles of fiber-optic cabling and a wireless mesh network throughout the city. While much of the technology is still being developed, most of the infrastructure is in place to further leverage the network's vast capacity for streamlined collection, transfer and management of city-wide data.

"We're using technology more and more to enhance how we deliver services. That's primarily the end goal: to deliver services in a much more efficient way than we have in the past."

Hugh Miller,
Chief Technology Officer,
City of San Antonio

Hugh Miller is chief technology officer for the City of San Antonio. He and his team design and support the network functions that allow the flow of data among the city's various systems. He manages a staff of roughly 340 IT and administrative personnel throughout all city departments.

Mr. Miller has a background in both electrical and computer engineering, and prior to his current position worked as an IT manager and network engineer. He has worked for San Antonio since 2004, and has been an integral part of the city's smart initiatives.

## Objectives

When Mr. Miller took over as CIO in San Antonio nearly 10 years ago, he found the city had a lot of technological catching up to do. "We were really far behind when I got here, and we had to take this rapid leap forward to update everything, and also to build stuff for tomorrow," he recalled.

A network engineer, Mr. Miller describes his first goal as coordinating the central management of San Antonio's data. With an operating budget of $63 million, he began by partnering with municipally owned CPS Energy and circling the city in fiber-optic cabling. He then started development of a citywide wireless mesh network.

This network is used for traffic, public safety, and justice applications. This range of network-based technology is aimed at improving customer service. "We're using technology more and more to enhance how we deliver services," said Mr. Miller. "That's primarily the end goal: to deliver services in a much more efficient way than we have in the past."

## Strategy

Working with the city's energy company CPS Energy, the City of San Antonio installed three concentric SONET rings around the city to form a fiber-optic backbone on which to deploy the city's technological solutions. This backbone supports a Wi-Fi mesh network that links traffic signals as well as some of the security and traffic cameras. The city also uses WiMAX technology for some of the network backhaul.

Capital-expense funding for San Antonio's Smart City initiatives came from a variety of public sources. Because the Smart City initiatives coincided with the original traffic synchronization project, Mr. Miller said that the initial expenses of the fiber-optic cabling installation and network infrastructure were covered by the Alamo Transportation District Fund. Ongoing maintenance and support is part of the city operating budget.

Mr. Miller indicated that many of the high-resolution cameras in public areas were paid for with funds from Homeland Security. The video court system, including imaging technology and kiosks, was funded through the Municipal Court Technology Fund, which is collected from a percentage of state-mandated fees on traffic fines and other infractions and criminal activity.

Mr. Miller worked with the San Antonio Transportation Division of Public Works to install a traffic light control system at each of the city's intersections. The system allows transportation personnel to monitor and control more than 1,200 traffic lights from a network-enabled terminal. The system can control cameras that provide visual information to traffic managers.

## Solution

### Networked Traffic Lights

Following installation of the fiber-optic network, Mr. Miller worked with the San Antonio Transportation Division of Public Works to install a traffic light control system at each of the city's intersections. The system allows transportation personnel to monitor and control more than 1,200 traffic lights from a network-enabled terminal. The system can control cameras that provide visual information to traffic managers.

Mr. Miller indicated that the city has moved toward using video cameras for traffic sensing in the traffic signal synchronization system. "Historically we've had weight sensors in the ground. They were very expensive and disrupted the street maintenance program," Mr. Miller explained. "Now we have motion cameras that are on the bulk of our traffic light poles. Those cameras also have the ability to shoot video. If there is an issue, we can view those cameras and see who we need to dispatch." Some of these cameras are hardwired to the network or connected wirelessly.

Crucial to the success of managing traffic is ensuring the exact timing of each light. "If we can have that time stamp accurate throughout, then whenever we configure a light sequencing, it can stay as accurate as possible," Mr., Miller explained.

Mr. Miller's department oversees communications for the city's Public Works Traffic Operations Division, which manages the traffic system. "We give them the ability to communicate," he says, "and they then work on the actual configuration of the lights." He stated that the system also can be accessed and controlled remotely after-hours. "The bulk of the team resides in a centralized location, but if someone got a call in the middle of the night and said, 'We're having an issue over here, can you log in and take a look at it?,' someone can do that," Mr. Miller explained.

## Municipal Court

Mr. Miller was also involved in the establishment of San Antonio's video court program, the result of a joint concept by Municipal Court Presiding Judge John Bull, Court Clerk Fred Garcia, and Mr. Miller. In an effort to improve service, reduce traffic to city offices, and extend judicial resources, Mr. Miller's team oversaw the implementation of a remote video system (telepresence). It allows court hearings via high-quality video conferences between San Antonio residents and Municipal Court judges at kiosks and link centers throughout the city. The program also helps resolve issues such as contested fines and traffic tickets through an online payment mechanism.

Mr. Miller indicated that other services are offered at the link centers as well, such as payment of utilities and fees, and the vending of permits. He plans to increase services available to the public in these venues as well as online. The system provides an opportunity, says Mr. Miller, "to both enhance our services and not force people to come downtown to handle their issue."

Each of San Antonio's police cars is equipped with an in-car video system and DVR. Any time the police engage their lights and siren, the video system automaticaly records video of what is taking place. Video data captured on the vehicle's DVR is uploaded automatically via Wi-Fi into localized storage as each officer arrives at the substation.

## Police Department

Each of San Antonio's police cars is equipped with an in-car video system and DVR. Any time the police engage their lights and siren, the video system automatically records video of what is taking place. Video data captured on the vehicle's DVR is uploaded automatically via Wi-Fi into localized storage as each officer arrives at the substation. Depending on the issue, these videos may become evidence in a particular case. "The officer's part of the process is to tag and put the metadata in the video," Mr. Miller explained, "and then it uploads into a database. We store it for 180 days if it's not part of a case, and forever if it becomes part of a case."

A valuable public safety enhancement was the installation of high-resolution surveillance cameras in areas at high risk for crime, such as city parks. Mr. Miller said that in addition to the cameras helping to decrease criminal activity, the video they produce can also provide a valuable tool for the prosecution of perpetrators. As the network's bandwidth grows, Mr. Miller intends to oversee further installation of these cameras throughout the city.

## Marshal's Office

Each of the court marshal's vehicles is equipped with a video-teleconferencing equipment and a credit/debit card scanner, which allow roadside resolution of outstanding warrants and unpaid fines. First, the cameras are equipped with automatic number plate recognition (ANPR) capability, which is a mass-surveillance method using optical character recognition to read vehicle license plates. ANPR can be used to store images captured by the cameras as well as the text from the license plate. Data from the ANPR capture is transmitted wirelessly to the network and checked against a database of vehicles and drivers with outstanding warrants or unpaid fines. The officer is informed in real time whether there are any issues with the vehicle or its registered driver. If so, the officer can connect the driver to a judge via a video-conference link from the officer's in-vehicle laptop computer. In many cases, the driver can immediately resolve his or her issues with the judge and, if necessary, pay a fine via an in-car electronic payment system. This has reduced the number of arrests and increased fine revenue for the city. "They've raised their

collections by a few million dollars since its implementation," said Mr. Miller. "In some cases, they can offer that person the ability to reconcile the issue right there in the car by teleconferencing with a judge and settling it. They put their credit card data in, and they clear up their warrant or their issue, and can move on."

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Hugh Miller,
Chief Technology Officer,
City of San Antonio

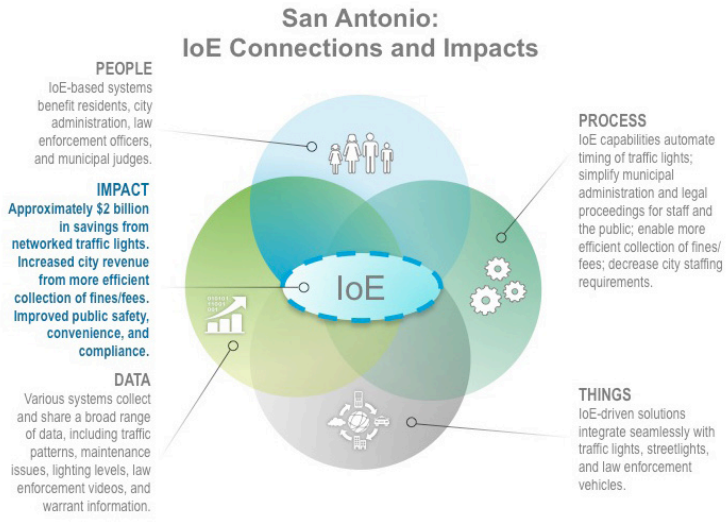
## Smart Streetlighting and Smart Parking

The city is currently upgrading the streetlighting system using sensor-based LED lighting technology. The system can automatically adjust the amount of lighting in less-frequented areas, depending on the level of activity.

Mr. Miller said that streetlight technology is currently being expanded. He said the sensors can use radio frequencies and IPv6 networking to allow the communication with lights within an area. The sensors can detect activity in little-used areas to automatically increase light levels as needed. "The LED light gives you a lot of options: some of them can change color, and on most of them you can change density," Mr. Miller explained. The lights of the LED are split into quadrants, or more options, where [for example] one fourth of [the lights are on] if it's not a heavily trafficked area, and if someone shows up, it then pops on full blast to give you the full light grid."

In the future, a smart parking initiative that informs both citizens and officials in real time of citywide parking availability and meter information is also planned.

**Figure 1.** San Antonio: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

San Antonio's technology has attracted broad national recognition. The traffic light synchronization initiative garnered a 2011 ComputerWorld Honors Program Laureate Status award for its contribution to city technology. Code for America chose San Antonio as one of its 2014 Fellowship Cities, recognizing the city "for their dedication to innovation and forward-thinking staff."

Mr. Miller indicated that synchronization of the traffic light system has greatly facilitated smoother traffic flow. Prior to the traffic-light synchronization, the city estimated that $2 billion was lost due to longer commutes, higher fuel expenses, safety issues, and other factors.

San Antonio's remote court system has provided a more efficient way to deliver judicial resources and city services to inhabitants in or near their own neighborhoods.

San Antonio's remote court system has provided a more efficient way to deliver judicial resources and city services to inhabitants in or near their own neighborhoods.

Integration of technology into law enforcement vehicles has dramatically reduced the administrative burden on police officers. Each officer has immediate access to data within the vehicle via the plate recognition program that assists law enforcement as well as legal staff. The ability to automatically record and store each encounter assists with both public and officer safety, and aids in the prosecution of criminals. The ability to collect outstanding fines has streamlined the collections process and reduced work for administrative and legal departments, resulting in increased revenue and reduced staff.

According to Mr. Miller, the immediate recording of – and easy access to – data means far less human error, contributing to a reduced administrative burden on officers and staff, thereby saving costs. Police have more time to serve the public, and the public can more conveniently discharge their obligations. Video surveillance contributes to the safety of both the officers and the public, and facilitates the prosecution of cases.

Advantages of San Antonio's smart streetlight technology include increased safety by providing brighter illumination where and when activity is present, and the conservation of both energy and public funds by decreasing light levels in low-traffic areas.

Mr. Miller explained that lights on the smart grid will be more efficiently maintained as well because maintenance personnel can detect exact locations of needed repairs when malfunctions occur. This contributes to both a timely and cost-effective response, and supports ongoing public safety efforts.

"Don't ever box yourself into how you think of things. There's a creative way to leverage technology no matter how difficult the problem. Don't restrict your thinking just because it either hasn't been done before or that someone's told you people have [already] tried over and over."

Hugh Miller,
Chief Technology Officer,
City of San Antonio

## Lessons Learned / Next Steps

Mr. Miller advises other cities looking to upgrade technological infrastructure to be resourceful. "Don't ever box yourself into how you think of things," he advises. "There's a creative way to leverage technology no matter how difficult the problem. Don't restrict your thinking just because it either hasn't been done before or that someone's told you people have [already] tried over and over."

San Antonio's fiber-optic and wireless mesh network is currently one of the largest. Mr. Miller believes that along with increased connections, transfer speeds, and bandwidth, location-based technology is going to become increasingly important in city systems. "We're doing a lot of GIS work for location components that are being leveraged in a lot of ways," he said. "As I look in the next few years, there'll be a lot more location-based information and analytics."

Mr. Miller expects camera surveillance systems to continue to be installed as bandwidth and monitoring systems grow. He predicts that these improvements will result in real-time dispatch of police and emergency vehicles in response to road emergencies, eliminating the need for eyewitness phone calls and expediting the arrival of assistance.

Mr. Miller indicates San Antonio is currently developing additional technology to expand the municipal services available on kiosks, and plans a large-scale expansion of kiosk availability throughout the city's largest grocery chain.

Mr. Miller continues to push for smart streetlighting throughout the city, and foresees the advantage of integrating a GIS mapping component for the precise identification and location of malfunctioning lights. "Right now one of the complaints of a lot of the council members is that a streetlight can be out and no one knows about it unless the constituent calls in," he said. He believes that timely repairs will contribute to both public safety and constituent goodwill.

While acknowledging that an automated system to identify and ticket parking offenders has its critics, Mr. Miller is an advocate for the technology, citing the reduction of administrative burden and the decreased number of people spending time in jail.

Mr. Miller's determination to pursue innovative change is a valuable contribution to the collaborative effort transforming San Antonio, and he is quick to share the credit: "We're definitely always trying to be ahead of other places. At the end of the day, I have a team of people that continue to dig in and try to deliver what we can with the budget we have and with the level of delivery that's available."

## More Information

For more information, visit http://www.sanantonio.gov

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# San Mateo County Harnesses IoE Capabilities to Reduce Traffic and Emissions, Boost Revenue



## EXECUTIVE SUMMARY

### Objective

- Bring technology and connectivity to all areas of San Mateo County, California

### Strategy

- Partner with state and city organizations, as well as with private companies
- Rely on small pilot projects to test technologies and determine which would be successful at scale
- Keep public informed about impacts and costs

### Solutions

- Free public Wi-Fi in city of San Carlos
- Countywide Smart Corridor transportation project to address traffic-flow issues
- Smart parking in cities of San Mateo and San Carlos
- Wi-Fi routers on streetlights in rural Pescadero to provide Wi-Fi Internet

### Impact

- Improved wired and wireless Internet access throughout county, benefiting government, cities, citizens, and businesses
- Smart parking cuts traffic congestion and emissions; benefits local businesses by allowing consumers to easily find parking spots; adds potential revenue to city and county sales tax bases
- Links roads overseen by Department of Transportation with local municipalities to create improved commutes and enable more efficient updating and management of signs and traffic signals

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About San Mateo County 'Smart Government'

San Mateo County, California, is located between San Francisco to the north and Silicon Valley to the south. Its population of more than 700,000 is spread across 20 cities, as well as suburbs and rural areas. San Mateo County has attracted industry, especially in the technology and scientific fields; companies headquartered in the county include Facebook, Oracle, Virgin America, and YouTube.

The Smart Government initiative is designed to bring technology and connectivity to all areas of San Mateo County. Projects include integrating parking sensors with an application to give motorists real-time parking options; a Smart Corridor highway project that monitors traffic through signs and transponders; and, eventually, Wi-Fi connectivity to all cities in the county, creating seamless connectivity between cities and transportation systems. In addition, San Mateo County is exploring ways to connect its rural towns through innovations such as wireless access points in streetlights. In each of these projects, county officials play an important coordination role, bringing together the efforts of both city governments and regional entities to provide cohesive services to county residents and visitors.

"We want to take advantage of some of the trends that are going on right now with open governments, Big Data, and broadband connectivity."

Jon Walton,
CIO,
San Mateo County

San Mateo County CIO Jon Walton oversees all IT-related infrastructure, budget, and employees for San Mateo County. He has 20 years of experience in the IT field, and previously worked in IT for the City of San Jose, California, Unisys Corporation, and as deputy CIO for the City of San Francisco. He has a bachelor's degree from Humboldt State University.

## Objectives

San Mateo County is highly diverse, encompassing both urban, high-tech areas and rural areas with very little technology infrastructure. "San Mateo County is pretty interesting," Mr. Walton explained. "You have what I call the 'East of 280 Corridor' – the high-tech area from South San Francisco down to Palo Alto, which is very dense, very economically affluent, and very high-tech-focused. Then you have what I call the 'West of 280' region, which is mainly agricultural, sparsely populated, and with not much technology at all."

According to Mr. Walton, the county manager saw potential in partnering with agencies and cities that are independent but closely related to the county in terms of the services they provide. The vision was for San Mateo County to be a facilitator and organizer of shared services to bridge the gaps between adjacent cities and townships. "We see San Mateo County as being a great test-bed for a lot of these ideas around what the new vision of government is," said Mr. Walton. "We want to take advantage of some of the trends that are going on right now with open governments, Big Data, and broadband connectivity."

San Mateo County's smart solution pilot and project portfolio include:

- Free public Wi-Fi in the city of San Carlos
- A countywide Smart Corridor transportation project to address traffic-flow issues along Highway 101 and El Camino Real

- Smart parking in the cities of San Mateo and San Carlos
- Wi-Fi routers on streetlights in rural Pescadero to provide Wi-Fi Internet

## Strategy

San Mateo County has partnered with state and city organizations, as well as with private companies, to initiate the San Mateo County Smart Government project. Participants include cities within the county, the California Department of Transportation, technology firms, and Internet service providers.

The county has also relied on small pilot projects, such as Wi-Fi in the city of San Carlos, to test technologies and determine which would be successful at scale. "Now we're trying to see how we can apply lessons learned from that pilot project to the entire corridor," said Mr. Walton. "The companies that are in our county, and even adjacent to our county, are great test sites for ideas we'd like to apply countywide."

"Now we're trying to see how we can apply lessons learned from that pilot project to the entire corridor. The companies that are in our county, and even adjacent to our county, are great test sites for ideas we'd like to apply countywide."

Jon Walton,
CIO,
San Mateo County

The county has issued press releases and posted information about ongoing and forthcoming projects so the public can be informed about impacts and costs. The San Mateo County Smart Corridor was funded with $35 million – $30 million of which was paid for with state grants. In the other projects, San Mateo County works with different municipalities and companies in public-private partnerships not only to build new connectivity solutions, but also to fill previously unconnected gaps. In this model, each shareholder retains ownership over the system or hardware, but provides access and cooperation with the county to ensure a more connected community.

## Solution

San Mateo County's Smart Corridor project includes directional signs, changeable message signs, microwave-enabled vehicle detection systems, and closed-circuit television cameras to provide traffic monitoring and emergency response assistance. Information is transmitted via both fiber and wireless networks. A fiber-optic communications system connects the Caltrans Transportation Management Center in Oakland to 10 San Mateo County cities. Sensors and CCTVs detect traffic volume and speed at various locations, allowing electronic message signs to display messages and offer alternative routes during incident or congestion times. The project also links 250 state and local traffic signals that can be remotely adjusted depending on traffic flow and congestion.

San Mateo County's smart parking pilot program uses wireless routers working in conjunction with a parking sensor network to provide parking availability data online. The routers communicate with sensors in parking spaces, aggregating collected data and communicating it to a cloud center. Consumers then access the relevant data, such as parking availability, through an app that is available for public download.

In Pescadero, a rural town west of Highway 280 with limited Internet service, the County of San Mateo is working with local telecommunications firms to provide Wi-

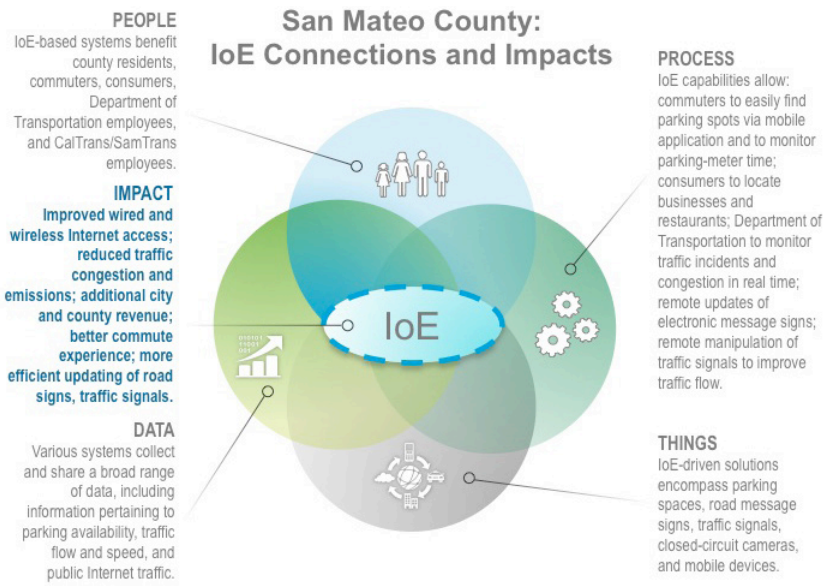
 

Fi installation approvals to help bring greater connectivity to the area. Wi-Fi routers are being placed on streetlights to allow residents and visitors to access Internet services. Similar Wi-Fi locations have already been deployed in San Carlos. Mr. Walton commented on how the knowledge gained from the Wi-Fi pilot in San Carlos transferred to the project in Pescadero: "You can take some of those things now that we've done in the high-tech corridor, in a very dense urban setting, and start seeing how we can apply them in very rural settings. One of the things [Pescadero] has is streetlights. We proposed to augment their existing light standards by placing a wired access point on every second or third streetlight. The entire town is going to be wired in the future."

In payment technologies, the county is collaborating with different integration vendors such as Software AG and SalesForce.com to find the best approach to create high-level software integration throughout the county. According to Mr. Walton, with this approach, "it doesn't matter where you are geographically, or what type of system you're trying to interface with. It still has that same application interface, same payment engine, same sort of streamlined experience."

Smart parking in the cities of San Mateo and San Carlos cuts traffic congestion and related emissions, and allows consumers to easily find parking spots, which benefits local businesses. It also adds potential revenue to city and county tax bases.

**Figure 1.** San Mateo County: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

San Mateo County's Smart Corridor project links the roads overseen by the Department of Transportation with local municipalities to create a more efficient commute. By connecting the communication centers and having remote-access capabilities to see real-time traffic information, message signs can be quickly updated from the centers; the county, cities, and Department of Transportation no longer have to travel to the message signs to update them. Traffic signals can also be operated remotely to accommodate traffic flow.

Smart parking in the cities of San Mateo and San Carlos cuts traffic congestion and related emissions, and allows consumers to easily find parking spots, which benefits local businesses. It also adds potential revenue to city and county sales tax bases.

As for rural Wi-Fi, Mr. Walton commented, "It's going to change, fundamentally, the connectivity of that town (Pescadero). More people are going to want to go and stay there because they're going to have connectivity. The people who live there or visit are going to be able to tap into government services or commercial services more easily."

"It's going to change, fundamentally, the connectivity of that town (Pescadero). More people are going to want to go and stay there because they're going to have connectivity. The people who live there or visit are going to be able to tap into government services or commercial services more easily."

Jon Walton,
CIO,
San Mateo County

## Lessons Learned / Next Steps

Ensuring seamless integration throughout the county is a challenge. "The technology is the same," said Mr. Walton, "but when you move to a different organizational model where you have a variety of geographic or political entities that all own a piece of it – different school districts, townships, towns, public agencies – how do you encourage individual creativity and innovation to test things out, but then help leverage successes so that everyone can take advantage of it?"

Working for San Francisco's IT department gave Mr. Walton insight into how a city that encompasses an entire county could own and easily manage integration of projects. By acting as the coordinator, Mr. Walton says the county can create positive experiences for consumers frequenting businesses. Mr. Walton pointed to the smart parking project as one example: "Every one of those towns owns its own parking meters .... If you're a citizen, what you don't want to hear is, 'You need a different app,' or, 'That it is a different type of sensor' every time you go to a different city. That's why the county can help – working with the cities and the other jurisdictions and transportation agencies. The cities can own their 'back ends' and have their own preferred technology, but the county can create higher-level integration to give residents the same seamless customer experience no matter where they go in the county."

San Mateo County will take the successes from pilot programs and integrate them into other cities – both urban and rural – as well as into public transit systems to create an entirely wireless, seamless connectivity experience for residents and visitors. "Each of the individual agencies has its own initiatives around creating a primarily wired, but sometimes wireless connectivity solution, primarily for their own use," said Mr. Walton. "We're trying to negotiate with each of these entities about adding a layer of connectivity to their infrastructure to fill in the gaps between where the systems don't overlap, so that on any of these systems, a portion of the bandwidth and the connectivity protocols and access points would be the same no matter where you are."

According to Mr. Walton, the key to making the seamless integration work between cities and agencies is to reiterate that ownership of the systems will not change hands. "We think we can negotiate a joint agreement among all the agencies, so that the people who are driving down El Camino Real, the people who are driving on Highway 101, the people who are riding on the trains or taking the bus would all benefit from the same connectivity experience."

San Mateo County recognized that improving Internet access in rural areas is a win-win for the connectivity provider and the government. As a result, it worked to ease the burden of technology companies looking to install connectivity in rural areas by helping with the permit process. “One of the challenges for telecommunications companies is the permit process; it’s been difficult for some telecommunications firms to get connectivity out there. So, we’re essentially going to help them get through that process to get the permits needed to build their communication connection points.”

Looking forward, San Mateo County is evaluating connecting the drop zones and all municipalities in San Mateo County into an integrated, seamless wireless system that brings benefits to residents and visitors who can easily access information about local businesses, and will connect rural municipalities that have never before had reliable connectivity.

## More Information

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# IoE-Driven Capabilities Help San José State University Create 'Anytime, Anywhere' Learning Experience



**EXECUTIVE SUMMARY**

### Objective

- Make technological improvements to promote "anytime, anywhere" learning experience

### Strategy

- Began with wireless assessment, then worked with partner to upgrade equipment and increase bandwidth by installing additional access points throughout campus
- Five-year plan includes immersive video technology and unified communications

### Solution

- Wireless network throughout campus; upgraded wired infrastructure; virtual computer labs; upgraded data center; WebEx for collaboration among students, faculty, and administrators; video-conferencing rooms for remote education exchanges; Lecture Capture for an archive of classroom discussions; digital signs for communication; IP video phone network integrated with messaging and virtual meeting capabilities

### Impact

- Increases avenues of learning, with significant cost savings for university
- Enhances the learning process by stimulating innovation
- Creates safer, more informed campus community.

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About San José State University

San José State University (SJSU) is part of the California State University educational system, which is in the midst of an ambitious technological upgrade. The five-year development began in 2012, and includes a wireless network throughout the campus; upgraded wired infrastructure; virtual computer labs; upgraded data center; WebEx for collaboration among students, faculty, and administrators; video-conferencing rooms for remote education exchanges; Lecture Capture for an archive of classroom discussions; digital signs for communication; and an IP video phone network integrated with messaging and virtual meeting capabilities for faculty and staff.

Terry Vahey is associate vice president of information technology services and chief information officer for San José State University. In this role, she oversees the university's technological infrastructure and improvements. Ms. Vahey joined the university in 2012 as deputy CIO and assumed the role of CIO in 2013. She came to San José State from California Polytechnic State University at San Luis Obispo, California, where she most recently served as director of technology services and information security officer.

In 2012, Ms. Vahey met with campus officials to determine the vision and needs of the university. They wanted to promote an environment that would seamlessly blend technology and education in a way that fosters learning, safety, and a sense of connection.

## Objectives

When Ms. Vahey joined the project two years ago, the university's wireless Internet offered unreliable and limited bandwidth, with only 700 access points scattered around the large campus. The university struggled to serve its students as technology and the expectation of wireless access grew. "When a new model of smartphones would come out, you'd see something on the nightly news about universities not having enough bandwidth. That definitely happened here at San José State," said Ms. Vahey. "People would get dropped and the connections weren't secure, depending upon the density of where they were, such as how many students were in a particular classroom. Students in the class might be able to connect today, but they couldn't connect next week, for example."

In 2012, Ms. Vahey met with campus officials to determine the vision and needs of the university. They wanted to promote an environment that would seamlessly blend technology and education in a way that fosters learning, safety, and a sense of connection. "It's really about providing students access to academic materials anytime, anywhere, and use of technology that is part of their whole education here," she said.

Ms. Vahey articulated the program's vision: "We have a strategic plan that identifies the vision of five goals. Three affect what we're doing today with infrastructure: Unbounded Learning, 21st Century Learning Spaces, and Agility Through Technology. They're visionary and create focus and direction to meet our goals. The principles outline an innovative and engaged learning community. To align with Vision 2017, we are implementing an infrastructure that enables collaboration for our campus community. This includes Wi-Fi ubiquitously across the campus, video and conferencing, as well as virtual labs and data center technologies."

## Strategy

Ms. Vahey began with a wireless assessment, and with a partner upgraded equipment to increase bandwidth and install additional access points throughout the university campus. “What we’ve done is interpret [our goal] to provide Wi-Fi ubiquitously across the campus and in all the classrooms,” she said. When finished, the updated wireless network will bring greatly increased bandwidth and more than triple the number of access points to reach virtually every building, including classrooms, study spaces, residence halls, and staff areas. Ms. Vahey believes the increased availability will promote the “anytime, anywhere” learning experience that the university seeks to encourage.

Other major projects being implemented under the five-year plan include immersive, global video lectures and lecture capture for students, and unified communications (messaging, video phones, and desktop video conferencing) for university employees.

Ms. Vahey began with a wireless assessment, and then chose to increase bandwidth and install an additional 1,800 access points throughout the university campus. The installation process is ongoing, and upon completion will bring the total to 2,500 access points. They will provide reliable and secure Internet access in virtually every building, including classrooms, study spaces, dormitories, and staff areas.

“It probably will take us until 2017 to complete our objectives in the campus strategic plan, but we will have transformed daily activities in a positive manner for our campus community in that short time,” she said, adding, “I’m excited for our students and faculty to be part of evolving the delivery of education here at San José State, to able to do things with other universities, in new ways..”

SJSU has governance and ownership over its recent technological infrastructure upgrades, and the IT department, which Ms. Vahey oversees, is charged with managing the project.

SJSU is a not-for-profit institution and is publicly owned and operated. It receives revenue from the payment of tuition and fees, and other support and grants from federal and state governments. SJSU had a budget of $28 million for the upgrades to its technological infrastructure. The first part of the program was funded by the sale of SJSU’s Educational Broadband Service spectrum. Additional funds come from the university’s IT services budget, a new student fee, and funds from the continuing education program.

## Solution

### Wireless Network

Ms. Vahey began with a wireless assessment, and then chose to increase bandwidth and install an additional 1,800 access points throughout the university campus. The installation process is ongoing, and upon completion will bring the total to 2,500 access points. They will provide reliable and secure Internet access in virtually every building, including classrooms, study spaces, dormitories, and staff areas.

### Video Lectures and Lecture Capture

SJSU has scaled technology deployment in the classrooms based on need. This includes installation of six fully video-conferencing- and recording-enabled classrooms that Ms. Vahey terms “next-generation classrooms.” “In the classrooms

that we call next-generation classrooms, we have just about everything you can imagine," explained Ms. Vahey. "In the classrooms that are not next-gen, we've got things that are in varying levels, ranging from document cameras to SMART Boards to multiple screens." Upgrades are ongoing and vary by classroom.

The immersive video lecture system allows SJSU educators to exchange teaching opportunities with students and visiting lecturers around the world within the classroom. Participants can see and hear one another, and participate live in the education process regardless of location.

Lecture-capture technology, also installed in select classrooms, allows the recording and future review of classroom content. The system allows recording from any H.323 or Session Initiation Protocol (SIP) video-conferencing system. The recorded lecture can then be published and viewed using a webcasting and video-sharing program that allows easy archiving and retrieval. Students can watch the content on desktops or mobile devices.

"Being able to review portions of the lectures again helps when English is a second language, and when the subject matter is dense. Students can review the lectue as often as they like, and prior to a test."

Terry Vahey,
Associate Vice President of Information Technology and Chief Information Officer, San Jose State University

The system uses Vyopta vPublish and integrates with SJSU's Student Information Services to publish the content for easy archiving and retrieval. vPublish applies SIS metadata during the creation of the content, automatically tagging each video with relevant information and eliminating the need for manual input. The system also creates defined security groups, automatically routing the video captures to the right locations.

Ms. Vahey says that lecture capture is very helpful, not just for students absent from class, but for those needing further review as well. "Here at San José State, we have a pretty high number of international students," Ms. Vahey pointed out. "Being able to review portions of the lectures again helps when English is a second language, and when the subject matter is dense. Students can review the lecture as often as they like, and prior to a test."

## Employee Communication

Ms. Vahey found a varied collection of phone technology upon undertaking the campus upgrade, and early examination revealed a need for a uniform campus system that brought faculty and staff together. "We ended up getting a unified communications system using IP technology so we could incorporate some of the other technologies that we were going to end up putting on top of this infrastructure," she said.

SJSU faculty and staff were provided with desktop video-conference capabilities and a unified communications system that included new video phones. The video technology especially was selected in keeping with another campus goal of promoting a "helping and caring" atmosphere.

Ms. Vahey believes the technology has done much to bring the campus together. "We chose video phones to foster a sense of connectedness and to enable collaboration with the campus community," she explained. Ms. Vahey indicated she feels that the increased face-to-face communication has helped to lessen the distance, saying, "You do have more of a sense of connection." The phones can also serve as a campuswide emergency broadcast system.

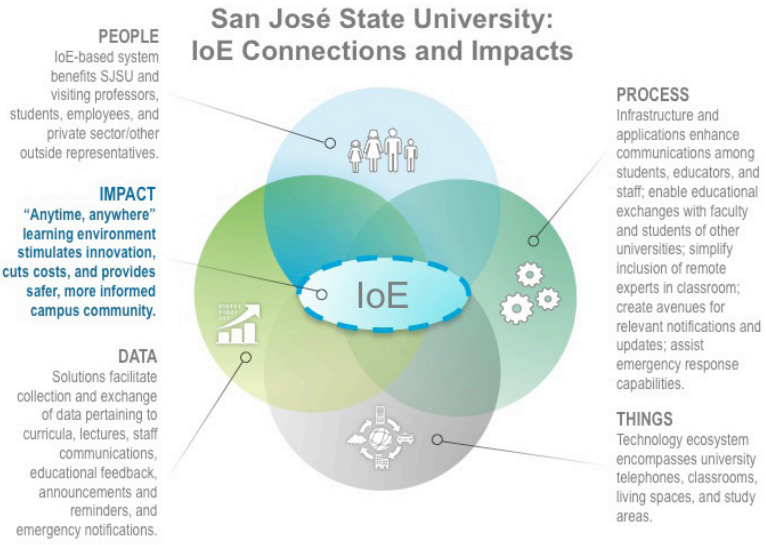
 

The new phones fit smoothly into existing technology, and have been very popular. "It's an integrated system," explained Ms. Vahey, "With the feature called Reach Me Anywhere, I can be talking on my desk phone and decide to walk to my meeting or go home, and I can hit my mobility button and the call goes to my cell phone. Seamlessly, the caller hears nothing more than me talking," she said.

Another upcoming project will increase student awareness, unity, and safety through a system of electronic signs placed throughout the campus. These will be used for emergency notifications, as well as campus announcements and updates.

Installation of immersive video conferencing in classrooms has greatly assisted learning exchanges with universities and organizations around the globe. Via live video feed, educators, students, and professionals from places such as New York, Viet Nam, and Afghanistan interact with students and faculty in SJSU classes.

**Figure 1.** San José State University: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

Installation of immersive video conferencing in classrooms has greatly assisted learning exchanges with universities and organizations around the globe. Via live video feed, educators, students, and professionals from places such as New York, Pakistan, Viet Nam, and Afghanistan interact with students and faculty in SJSU classes. "That was one of the things that was most exciting for us – the ability to do that for people and give them the technology to basically bring the world to the students," Ms. Vahey said.

Ms. Vahey indicates that the response has been strongly positive among educators grasping the significance of the next-generation classrooms, and they are putting the technology to good use. "People come in from remote locations; usually they'll be either visiting professors or visiting experts from industry or another country. In addition, we also have professors who will go to other locations and teach in another city or country. We have them set up with Afghanistan, Vietnam, and Pakistan," she said.

Increased connectivity also supports the "anytime, anywhere" educational ethic of the university. This capability makes it easy to access online educational content,

and to modify and notify students about course requirements. It also facilitates communication between educators and students, and among campus employees. Additionally, students appreciate the ability to review archived video lectures in preparation for tests.

Ms. Vahey highlighted another creative use of the technology. One professor with connections at a major ad agency in New York City and London utilizes the technology to allow students to present their ad campaigns to advertising professionals across the country and get their professional feedback. "Now that they have TelePresence in their room, when [students] are presenting their material and their project, it's presented on the screen behind them. Since we have three screens in the class, they have an opportunity for the people from New York to join their class, and the remote participants can see the students." The speed with which the exchange occurred surprised even Ms. Vahey. "That's what's really cool. Using the technology in the course occurred instantly, as soon as we had those rooms available. That's not something that we had expected, to have that be so soon."

"We need to make sure we show our successes along the way. It's really hard for people to understand progress without seing it, especially when there are expenses going into IT."

Terry Vahey,
Associate Vice President of Information Technology and Chief Information Officer,
San Jose State University

Video-conferencing and collaboration technologies assist the learning process by stimulating innovation. "We have partnerships with several universities where we help them learn how to do training and education in specific technologies, or specific genres of education," Ms Vahey explained. "Instead of having to travel over there as frequently, we are able to conduct classes and meetings with them via TelePresence and WebEx." This new capability results in increased avenues of learning and a significant cost savings for the university. "In terms of psychology value, the faculty who are using the new technology are absolutely thrilled with it. They love being able to bring the world to the students," Ms. Vahey stated.

The technology also contributes to a safer and more informed campus community. The system of electronic signs, soon to be installed throughout the campus, and the InformaCast emergency broadcast system expected to be available on the phone system this year, both allow instant notification and provide valuable information in case of emergencies.

## Lessons Learned / Next Steps

Ms. Vahey has learned several important lessons in the process of completing her many projects. Overall, she describes the largest challenge as one of public perception. Educators might be impatient with classroom interruptions, or unaware of the progress being made. "We need to make sure we show our successes along the way. It's really hard for people to understand progress without seeing it, especially when there are expenses going into IT," Ms. Vahey said. She describes the problem with an analogy: "We're flying a 747 [and] we are changing out one of the engines, and we're acting like the people inside still get to have their dinner. Some of our challenges have been getting that to be right the first time, and communicating it to the campus."

Ms. Vahey has hired a PR assistant to help present accomplishments in a favorable way, highlighting the individual success stories of the large-scale project. "We're tripping along the way, but if you're doing some good things, then you need to be telling people, and that's a big lesson. We're getting better at that."

Figuring out the exact configuration of the next-generation classrooms was another challenge, and important for optimizing the results. "If you set the room up [properly], a person feels fully immersed, like they're in a space with a person there, they are with you," she said. "That really needs to include several things, especially if you're doing it in a big room. It needs to include sound equipment and speakers, recording equipment, microphones, screens, and displays, and they have to be set up the way that aligns with your expectations. Our challenges have been getting everything to work the way we expect it to, every time. It took us a few times through our pilot phase to find the right setup; learn about the tips that were necessary, as it was all new to us; and get some expertise built within our teams."

"We are transforming the way we deliver education, conduct meetings, communicate with each other on campus and off, and the way our campus community collaborates."

Terry Vahey,
Associate Vice President of Information Technology and Chief Information Officer,
San Jose State University

Because of the newness of the technology, the speed of implementation, and the importance of "getting it to be right the first time," Ms. Vahey is considering hiring a consultant to assist in optimizing the many new systems. She is hiring additional staff as well.

By 2017, Ms. Vahey anticipates full completion of SJSU's wireless network, wired network upgrade, data center upgrade, computer labs, WebEx deployment, VoIP deployment, video-conference deployment, installation of the electronic sign notification system, and the addition of many more next-generation classrooms. She plans to complete an additional 30 upgraded classrooms this year, including 10 currently under construction and another 20 beginning in summer 2014, bringing the campus total to 36 by the end of the 2014 academic year.

"We are transforming the way we deliver education, conduct meetings, communicate with each other on campus and off, and the way our campus community collaborates," Ms. Vahey concluded.

## More Information

For more information, visit http://www.sjsu.edu

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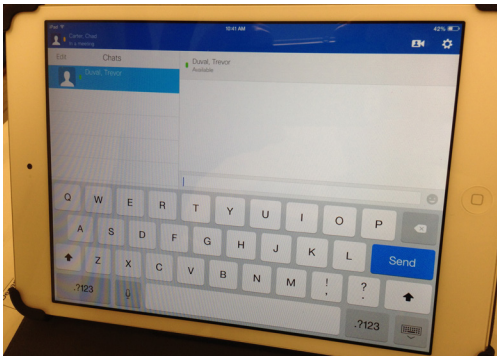
# Sault Area Hospital Taps IoE to Cut Costs and Provide Simpler Management of Building, People, Information


**EXECUTIVE SUMMARY**

### Objective

- Simplify operations and reduce staff workload, while improving the overall experience for patients, doctors, and management

### Strategy

- Built the solution from the ground up, enabling the team to consider how integrating systems could benefit hospital management, staff, and patients

### Solution

- Technology infrastructure designed to support patient and business processes, coordinated through – and layered upon – a single network
- Network integrates daily management of utilities, surveillance security, telephony, and patient monitoring

### Impact

- Enables simpler management of the building, people, and information
- Saves money and energy via lighting and climate-control functions of network
- Economizes IT processes through new, centralized infrastructure
- Enhances ability to offer state-of-the-art healthcare with an integrated patient experience
- Streamlines communications between patient and provider, enabling easy access to remote specialists

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Sault Area Hospital

Opened in March 2011, Sault Area Hospital (SAH) is a 600,000-square-foot, 291-bed facility that includes a 24-hour emergency department; acute, rehabilitation, and complex continuing care inpatient beds; surgical services; maternity and pediatrics; mental health and addictions; outpatient clinical services; diagnostic imaging; full laboratory/pathology services; and is also home to the Algoma Regional Renal Program and the Algoma District Cancer Program, complete with a radiation treatment complex.

SAH is a publicly owned and operated nonprofit institution, governed by a Board of Directors comprised of members of the local and regional community. Assets, income, expenses, and other budgeting information are publicly disclosed. The construction of the Sault Area Hospital building was funded by the provincial government of Ontario, Canada.

By integrating daily management of utilities, surveillance security, telephony, and patient monitoring into this IP network, Sault Area Hospital simplifies operations and reduces workload for staff.

Chad Carter is the enterprise architect for Sault Area Hospital. He is an experienced network specialist who assisted in the design of Sault Area Hospital's technology infrastructure. He previously worked for the same facility as ICT manager, and as an IT manager for Grand River Hospital.

## Objectives

The new Sault Area Hospital utilizes technology infrastructure designed to support patient and business processes coordinated through — and layered upon — a single network. By integrating daily management of utilities, surveillance security, telephony, and patient monitoring into this IP network, SAH simplifies operations and reduces workload for staff. Patient histories, provider-to-provider communications, and administration and building management functions are centralized in a secure, remotely accessible data center. The new infrastructure features a common platform for patient care, including simple methods of sharing patient histories with physicians outside the hospital. SAH also actively collaborates with the Ontario Telemedicine Network as a provider and in training events.

## Strategy

Mr. Carter described the process of planning for the new facility: "Since the facility was a completely new build, that gave us an opportunity to build from the ground up, which is kind of rare in the technology arena — especially in healthcare, where you're usually marrying technology into older buildings and trying to make things work. We were able to plan from the ground up and say, 'What technology will best support the business operations? Let's build a building that can house those properly.'" This sort of thought process allowed Mr. Carter and his team to consider how integrating systems could benefit hospital management, staff, and patients.

## Solution

### Patient Care Communication

The central network streamlines patient care by storing data machine-to-machine. "Where the data itself is able come across electronically, that information can be automatically captured into our EMR (electronic medical record) instead of having the nurse enter it manually," Mr. Carter explained. It minimizes mistakes and errors, and [reduces] cycles on the clinician who's taking care of the patient." Sault Area's electronic medical records are then available via the network for doctors, so they can monitor patients even when they are not onsite.

"We have the Telemedicine Network configured to use our hospital network. We're able to deploy that where we need. Whether it would be in the ICU or auditorium or a classroom or ER, we're able to easily activate ports on our network that support the Telemedicine Network. It's definitely a service that we use very often."

Chad Carter,
Enterprise Architect,
Sault Area Hospital

In addition to saving steps for staff, the central storage of patient data supports data security. Mr. Carter added that "data privacy and security definitely are forefront items." Patient data is kept in a secure central database, rather than stored on mobile devices or desktops, and is easily accessible to authorized personnel wherever they are. Mr. Carter noted that these data trails are periodically checked for anomalies: "We have audits that check both access and what they're accessing, and should they be accessing that particular record within the circle of care." Sault Area Hospital mitigates risk by keeping sensitive data secured within the facility.

The network also provides Wi-Fi for public and internal use. It integrates a wired as well as wireless telephone system in place of a traditional paging system. Mr. Carter describes this as "a huge change for the organization," saying, "In the past, a patient sitting in a bed might press the nurse call bell and it would ring up the nursing station. Now, the call bell actually sends that alert directly via wireless phone to the nurse who is responsible for the patient. It removes geographical limitation, letting nurses move around and still receive alerts right away. This allowed us to remove our old PBX system and really leverage the new wireless technology."

### Provider-to-Provider Communication

The hospital collaborates extensively with the Ontario Telemedicine Network, the province's main avenue for provider-to-provider communications. "We have the Telemedicine Network configured to use our hospital network," Mr. Carter explained. "We're able to deploy that where we need. Whether it would be in the ICU or auditorium or a classroom or ER, we're able to easily activate ports on our network that support the Telemedicine Network. It's definitely a service that we use very often." This network provides a teleconference bridge for specialist consultations and referrals, and Sault Area Hospital acts as a main forum for provider education – offering both live-feed education and access to a large archive of recorded material.

### Building Management

New IT infrastructure supports central management of building functions. For example, the facility is wired throughout with both light and motion sensors. "We layered in an IP lighting environment," Mr. Carter explained. "We have lots of natural light coming into the building. Usually your lights are on or off, but in a hospital with 24/7 operation, you can imagine those lights never turn off. So, the lighting environment has sensors that monitor ambient light – reducing lighting load in the day and bringing it back up during the evening. All that translates into savings on overall power. It's a nice green item." True to the vision of using a single, integrated

system, Sault Area Hospital also manages its heating and cooling systems over this IP network.

Remote connectivity plays a large role in terms of simplifying building control. "They're able to set schedules on when we'll be in the building so lights will go off automatically and then come on based on motion," Mr. Carter said. In the evenings, SAH uses on-call staff who are able to monitor the environment and change settings remotely. "As long as you're on the network, you have access to those services," Mr. Carter explained.

In addition to making facilities management remotely accessible for maintenance staff, employees can unlock and adjust building functions based on room use. Access is granted by card interaction with RFID readers and a proxy-based HID access control reader. Mr. Carter indicated that hospital security systems, including video monitoring, are centralized as well. The cards provide a level of security by recording access details, such as employee name, date, and time.

"Everything is connected, right down to the incoming power feeds in the system. So our maintenance folks are able to manage that environment without having to walk to the panels, for example, to make a change or monitor our system. All the cooling, heating, and power controls are network-connected, and the team is able to manage that."

Chad Carter,
Enterprise Architect,
Sault Area Hospital

"It's all controlled by one card, our ID badge," Mr. Carter explained. "An ID badge not only gives staff access to doors, but it also gives them access to their parking. We're able to determine who has access to what, and to what area of the hospital. We can track the date and time access happened."

Controls for room environments can be optimized simply through the network. "Everything is connected, right down to the incoming power feeds in the system. So our maintenance folks are able to manage that environment without having to walk to the panels, for example, to make a change or monitor a system. All the cooling, heating, and power controls are network-connected, and the team is able to manage that," Mr. Carter explained. Having the controls in one location simplifies the work of maintenance and increases overall efficiency.

Lighting is connected to the network throughout the building. Lights in unoccupied offices are automatically turned off and on based on movement.

## Telephony System

Mr. Carter indicated that the opportunity to build "from the ground up" facilitated the inclusive nature of the network infrastructure. "We started off with a mandate of 'everything on the network.' We went from a PBX environment to a fully IP-based, voice-over-IP environment. Now, we can deploy telephony anywhere – wired or wireless – throughout any part of the building," he said.

"We have corporate wireless for our laptops and handhelds, and also voice on the same network, and then we also have our guest wireless," Mr. Carter continued. Clinical staff and members of the nursing staff carry wireless phones, which allow free movement around the building. These phones serve as the main communication tool, and integrate the nurse call system.

## Patient Care

According to Mr. Carter, traditional patient-monitoring systems are generally isolated on their own physical network. At SAH, monitoring is combined with other network functions. Mr. Carter stated, "We moved forward when we implemented our patient-

monitoring network here – cardiac monitoring and telemetry [and so on]. We actually layer that right onto our hospital network, right alongside patient systems and administrative systems – everything, including telephony, all on the same network."

Not only does having patient monitoring on the network facilitate better patient care, but it also allows the hospital to manage facilities differently in the context of patient care. Mr. Carter explained, "We're able to leverage the network capabilities with patient monitoring. For instance, if I need a patient monitor in a new room on the other side of the building, all that is required is a simple network port configuration." Without the network, they'd be up against extending a private network and cabling across the building, which wouldn't be nearly as feasible. "Now, we're able to have that flexibility and install monitoring where we need it. Whether the ER needs another room activated or the ICU, we're able to do that with very little effort, and on the same network," Mr. Carter reported.

"We moved forward when we implemented our patient-monitoring network here – cardiac monitoring and telemetry [and so on]. We actually layer that right onto our hospital network, right alongside patient systems and administrative systems – everything, including telephony, all on the same network."

Chad Carter,
Enterprise Architect,
Sault Area Hospital

Sault Area Hospital utilizes virtual storage for clinical data, which Mr. Carter described as "85 percent virtualized on the back end." He said, "We're a big virtualization shop. Within the last four years, we really ramped up that piece."

## Remote Access

The network's firewall allows controlled access for employee groups, including remote access to the central database and building management functions. "A lot of them are able to connect in and monitor our systems or remotely change settings, whatever they need, just as if they were here," Mr. Carter explained. "As long as you're on the network, you have access to those services." This integrated network makes data easily available, and simultaneously controls who can access what information.

This network functionality has been expanded to be compatible with offsite Sault Area Hospital campuses as well. "We actually manage some of our remote campuses that way – you might have the management application on the main site, but the systems are being managed remotely. Remote connectivity is a huge piece of our environment," Mr. Carter explained.

## Administration

Sault Area Hospital consolidated printers, faxes, and scanners into a single platform. Mr. Carter explained: "We deployed a large fleet of multifunction devices throughout our facility, including fax, scanners, and photocopiers, so we've consolidated that down quite a bit. For the equipment that we deployed, the footprint is definitely a lot smaller than before."

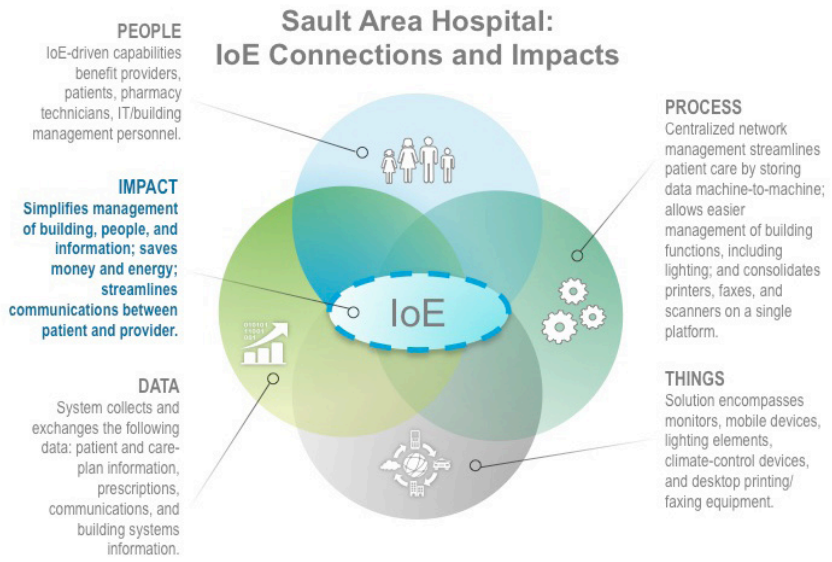
Because the hospital still relies heavily on faxing technology, the new equipment incorporated a system of print-on-demand electronic faxes. Mr. Carter described the process of rethinking faxing as the preferred method for transferring information from hospital to pharmacy: "On top of that multifunction strategy, we changed the way that we deliver our drug orders, or how a drug order for a patient gets to the pharmacy. Before we had this new building, all that happened via fax."

With the technology available over the IP network, faxing has become outdated. The hospital's new method was far more efficient and environmentally friendly. "We wanted to keep the same feel, so the nurse still walks up to the device, puts the order in, and selects the pharmacy from the contact list," Mr. Carter explained. "Now we simply route this message to an electronic inbox so the pharmacy gets their 'faxes' via email. For example, in our IT department, all of our faxing is electronic – everything comes in as a PDF and it's distributed that way." This new method allowed the hospital to centralize management of faxing in terms of the number of phone lines needed to support the environment.

With the technology available over the IP network, faxing has become outdated.

**Figure 1.** Sault Area Hospital: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

The new Sault Area Hospital has been well-received by patients and the community. It received a 5-star Energy award in 2012 for wise conservation of resources, acknowledging its commitment to green practices.

The benefits of Sault Area Hospital's consolidated network show up in the relative simplicity of managing the building, people, and information. The lighting and climate-control functions of the network save money and energy, simplifying building management. The new, centralized infrastructure also economizes IT processes. Mr. Carter's team of 20 individuals can handle all aspects of IT in the large complex: service desk, PC tech, desktop support, network server, data-center applications, and business support telephony. "We have fewer [IT] providers at the table right now," said Mr. Carter. "We do a lot of our management internally, which allows us to be very flexible. That, in turn, benefits our business." With an integrated network that replaces stand-alone systems, Sault Area Hospital can focus its IT resources more effectively.

The IP network enables SAH to support patient and doctor needs more efficiently. In addition to offering state-of-the-art healthcare, Sault Area Hospital offers an integrated patient experience. It streamlines communications between patient and provider, enabling easy access to remote specialists through the Ontario Medical Network. The hospital also works closely with the network as a training forum for physicians.

In terms of managing information, the network creates a secure platform for ongoing transactions among medical providers, administrative staff, and pharmacy personnel. It enables secure, remote access to patient monitoring and history, and simplifies administrative processes.

"When you take all of those components, it does make for a fairly integrated and involved environment," stated Mr. Carter. "It's been a lot of work, and you definitely need to have the proper resources available, but we see the benefits." From his perspective, the investment in the building and new technology pays off every day.

The IP network enables SAH to support patient and doctor needs more efficiently. In addition to offering state-of-the-art healthcare, Sault Area Hospital offers an integrated patient experience.

## Lessons Learned / Next Steps

While the new infrastructure has largely improved processes, it required some initial staff adjustment. "Within the first year of moving in, we definitely had to take some time getting used to new processes throughout the facility," he said, although he clarified that they haven't had any problems with the technology itself.

If he were providing advice to other hospitals or organizations who are interested in implementing similar technology, Mr. Carter would emphasize the importance of finding strong partnerships and internal champions for a project of this scale. "If you don't have that one person or team driving, it's not going to be successful. I don't care how good the technology is – if you don't have the people from both the hospital side and the vendor side to deploy, it's very easy for stuff to get dropped, and then it's not successful. It could be the most awesome technology in the world, but you have to match that with the people and processes to support it."

In terms of future plans, Mr. Carter explained that there are many ongoing initiatives, but some of the bigger ones lean toward virtualization. He continues to work with desktop management, and with moving data from the edge to the center. Sault Area Hospital is upgrading workstations and organizing data so that it's easily presentable to staff and clinicians. Regarding the Internet, he noted, "I see huge uptake in wireless – our wireless network is probably one of the biggest areas. From a wired perspective, there is growth, but the spike we see from wireless is pretty immense." Incorporating more wireless technology into its network will undoubtedly increase Sault Area Hospital's ability to provide quality care.

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# TxDOT Harnesses IoE Capabilities to Improve Communication and Reduce Accident Levels


## EXECUTIVE SUMMARY

### Objectives

- Proactively communicate I-35 construction issues and traffic-flow status to general public

### Strategy

- Implement intensive, multilayered communications campaign to alert drivers and long-haul truckers about I-35 construction and specific closures

### Solutions

- "Mobility coordinators" assist in over-seeing different contractors involved in project
- Cameras and monitoring stations track traffic flow
- Automated communications system provides construction updates to contractors
- Incident Alert System mitigates impact of unplanned roadway closures
- End-of-Queue Warning Systems enhances worker and driver safety
- Public announcements through my35.org, email, and Twitter blasts keep public informed

### Impact

- 80 percent of survey respondents have found My35 emails useful
- 83 percent think the dynamic message signs are useful/helpful
- Improved project coordination across various sections and contractors
- Reduced accident levels in planned mainline closures

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About TxDOT

Interstate 35 (I-35) is a major route for North American Free Trade Agreement (NAFTA) commerce among the United States, Mexico, and Canada. At more than 1,500 miles, it is the third-longest north-south interstate route in the United States. Up to 110,000 vehicles a day travel along I-35 in the state of Texas, 25 to 35 percent of which are long-haul truckers.

The Texas Department of Transportation (TxDOT) I-35 Corridor project began when officials realized that about 96 miles of the interstate within the Waco District needed to be rebuilt and expanded to accommodate maintenance and growth. When completed, the construction will standardize the road width through this region to a minimum of three lanes in both directions, with continuous frontage roads. It is the largest upgrade of I-35 since its initial construction. The I-35 Integrated Construction Management (ICM) Project covers 80 of the 96 miles of interstate through the Waco District, located between Austin and Forth Worth, Texas.

TxDOT implemented an intensive, multilayered communications campaign to alert drivers and long-haul truckers about the construction and specific closures. Communications platforms include email distribution lists, dynamic message signs along the highway, real-time Twitter updates, and my35.org – a website with mobile capabilities providing real-time travel information.

Jodi Wheatley manages all of the public communications for the I-35 construction zone, including public-facing emails, Tweets, and telephone inquiries. She receives updates from the various contractors about when various work zones will be active, and updates information for the public accordingly.

## Objectives

TxDOT believed that, given I-35's criticality and traffic volume, it would be important to communicate construction issues and traffic-flow status to the general public. The agency wanted to be proactive about reaching out to drivers and other interested individuals and entities such as emergency responders, trucking and shipping companies, and others who use or have responsibility for the roadway.

## Strategy

TxDOT implemented an intensive, multilayered communications campaign to alert drivers and long-haul truckers about the construction and specific closures. Communication platforms include email distribution lists, dynamic message signs along the highway, real-time Twitter updates, and my35.org – a website with mobile capabilities providing real-time travel information. The website also provides traffic-camera views, a map with real-time traffic flow information (received from monitoring stations along the highway), incident alerts, and information about current and upcoming closures.

The cost of the overall I-35 project is $1.9 billion, which includes construction and right-of-way acquisition. According to Ms. Wheatley, the Texas A&M Transportation Institute, which consults on the project, has three separate ITS contracts with TxDOT, including the one with the Waco District for $12.5 million. The other two fold in additional area and research levels.

## Solution

Due to the distance involved, and because it encompasses three counties and about 15 cities, the I-35 ICM Project was broken into 12 different programs that necessitated multiple contractors. The overall project's complexity and scope demand constant communication among different contractors, so TxDOT decided to manage it entirely in-house, which had never been attempted for such a large project. Currently, there are 66 miles of active construction, with the last currently funded project expected to finish in 2018. "An awful lot of it is out of one project, right into the next," said Ms. Wheatley. "We realized early on that somebody was going to have to keep an overall view, since changes to one project impact the next one down, and so on until the next thing you know, project five is experiencing unacceptable delays."

TxDOT implemented a series of cameras and monitoring stations to track traffic flow. This data allows TxDOT to estimate drive times and inform drivers about areas of heavy traffic, while also being used to determine construction patterns that will impact drivers the least.

### Mobility Coordinators

TxDOT brought on Texas A&M Transportation Institute (TTI) as a project consultant. TTI is an international transportation research institution associated with Texas A&M University, based in College Station, Texas. TTI provides three of what are called "mobility coordinators", who synchronize the work of different contractors involved in the project. Mobility coordinators' performance is judged by a simple metric: on average, having a 36-minute delay or less at any given time over the entire 80-mile construction area. Each mobility coordinator is responsible for a subset of the 12 total construction projects.

### Monitoring Stations

TxDOT implemented a series of cameras and monitoring stations to track traffic flow. This data allows TxDOT to estimate drive times and inform drivers about areas of heavy traffic, while also being used to determine construction patterns that will impact drivers the least.

Forty solar- and battery-powered monitor stations are located along the I-35 corridor. The monitors rely on signals from vehicles that have a Bluetooth device onboard to calculate their speed (and thus the speed of traffic through the zone) based on the time it takes to travel from one monitoring station to the next. Bluetooth signals are unique, making it possible to match instances of a signal from station to station. The same Bluetooth data is also used to perform predictive analytics – for example, to estimate the impact of planned lane closures on a certain stretch of I-35. For privacy reasons, TxDOT does not retain any Bluetooth information that is identifiable.

Information from the monitors is sent in real time to a central computer via cellular connection for analysis. Outliers and junk data (such as vehicles exiting and re-entering the highway, and bicycle traffic) are removed, and the average speed is calculated. Results of the analysis are then pushed to dynamic digital road displays, which show the expected travel times to different exits; and to the my35.org website's dynamic map, which displays current road and traffic conditions.

Seventeen of the monitoring stations have Wavetronix units that count and categorize vehicles by type (automobile, long-haul trailer, and so forth) for research

purposes, and eight of the monitoring stations have cameras that the public can view, also at my35.org. One of the cameras is recording construction on first-in-state bridges, and is also used as a traffic camera in a heavy traffic area.

## Automated Communications to Contractors

TxDOT has automated much of the workflow associated with coordinating construction plans and resolving possible conflicts among contractors working side-by-side.

First, all contractors are required to provide critical documentation on progress, impending lane closures, and other items by email or on paper. The details are then uploaded into the automated system. The system prints and sends automated forms such as lane-closure notices, equipment requests, and internal documentation to the relevant parties at the right time.

To mitigate the impact of unplanned closures, TxDOT has implemented an Incident Alert System. A worker can access the system via his or her mobile phone to quickly and easily input critical details. The information is routed internally so that relevant crews are dispatched to rectify the situation; some details are also made public so that drivers can make route corrections.

## Incident Alert System

While the automated contractor information system is useful for managing day-to-day paperwork and activities, unplanned closures — for example, caused by a traffic accident, or by severe weather — present problems for drivers and the construction process. To mitigate the impact of unplanned closures, TxDOT has implemented an Incident Alert System. A worker can access the system via his or her mobile phone to quickly and easily input critical details. The information is routed internally so that relevant crews are dispatched to rectify the situation; some details are also made public so that drivers can make route corrections. The system is especially powerful because it is easy for workers to use on-site; if the process were cumbersome, issues would go unreported or reported too late.

## End-of-Queue Warning System

The End-of-Queue Warning System was instituted following a cluster of wrecks during one construction project that resulted in five fatalities over a two-month period. The system was designed to enhance worker and driver safety, as well as driver awareness of upcoming, dangerous conditions around and in the construction zone.

The system relies on a combination of radar-enhanced orange-and-white traffic barrels (drums) and temporary rumble strips. First, the radar embedded in the barrels measures traffic speed; data is sent to a central server, which analyzes it and reports travel delays into digital display signs (similar to the monitoring station system). The temporary rumble strips act as speed bumps, and are positioned so that when drivers pass over the strips, the noise and bumpiness alert drivers to look up and immediately see the message signs. Ms. Wheatley explained: "If there's no delay, it says 'roadwork ahead.' If it starts recording a delay, it loops through a series of messages based on the situation, from 'slow traffic two miles ahead,' to 'slow traffic one mile ahead,' to 'stopped traffic two miles ahead.'" In this way, drivers can prepare specifically for what's coming.

The End-of-Queue Warning System is independent from the rest of TxDOT's information gathering and does not feed into its normal system. Some contractors subcontract the equipment and setup, and one has purchased the equipment to

use in its work zones (monitoring units are independent and can be attached to equipment other than drums).

## Public Announcements

Informing the public of construction conditions – which is carried out through the website my35.org, email, text message, and Twitter blasts – has been a crucial component to the project from the outset. According to Ms. Wheatley, "From TxDOT's standpoint, one of our major concerns about this whole process has been keeping the public informed. Even if they're not using the information yet, a lot of people feel better knowing that it's available if they need it."

A major feature of the website is the map of current driving conditions. A color spectrum reflects the average traffic flow. By hovering on the map, people can view northbound and southbound average speeds in pop-ups.

To begin building an email database that would reach the public, Ms. Wheatley invited key stakeholders to sign up to receive emails. She reached out to city and county government officials, school districts, chambers of commerce, and first responders. Each agency had its own database of employees and constituents. The idea was that if individuals in each of these agencies signed up for the alerts, they could forward news to many others. "It is built to be a network of networks," said Ms. Wheatley. "So with one rock, we have a lot of ripples."

The TxDOT has designed three different kinds of auto-generated email notices, to which the public can subscribe based on specific need and region: 1) daily notices on traffic flow for commuters; 2) seven-day regional outlooks focused on construction plans; and 3) high-impact announcements sent only when all lanes of a section are planned to be closed on one or both sides of I-35. High-impact closures are also announced by press release, on the website, and by text message. Emails go out between 5 a.m. and 6 a.m. on their scheduled days, and then the daily version again at 4 p.m. if any last-minute revisions have been reported before the evening commute begins. TxDOT also configured a special traffic alert report for unplanned closures (usually crashes) that is sent by email or manually whenever needed. The department continually works to improve each release of information so it is tailored as specifically as possible to every recipient.

The my35.org website provides a variety of data on project plans and current information feeds. The website is mobile-friendly, but not strictly a mobile app because TxDOT does not want to encourage unsafe driving behaviors. "It is set up to be friendly for cell phones, but it's not really strictly an app at this point. TxDOT may develop an app in the future, once it develops guidelines for which features and information can be provided while ensuring driver safety," Ms. Wheatley explained.

A major feature of the website is the map of current driving conditions. A color spectrum reflects the average traffic flow. By hovering on the map, people can view northbound and southbound average speeds in pop-ups. The map also shows the message sign locations and displays, and the website features a trip planner and weather conditions.

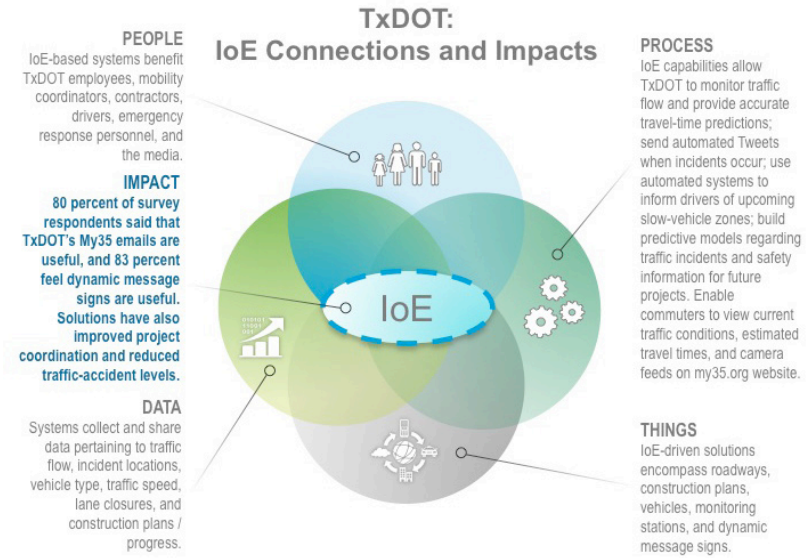
TxDOT's two regular Twitter feeds, both of which are manually operated, are "@I35travel", which the agency makes available for all public information officers in districts containing a portion of I-35 to use for updates (members of the public often send questions or information in response to the updates, giving a more complete picture of the state of the highway); and the Waco district feed ("@

TxDOT's safety and communication measures were so effective in reducing accident levels that the agency has begun to implement them along normal roadways where there is no construction.

TxDOTWacoPIO"), which Ms. Wheatley updates. Tweets are also automatically generated to the Twitter handle "@My35Traveltimes" when the average driving speed for a particular stretch is generating delays of five or more minutes; the information is the same as what drivers see on the automated digital road signage. These Tweets are set to refresh at five-minute intervals for as long as the condition continues.

**Figure 1.** TxDOT: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

Travelers have indicated satisfaction with the information they're receiving from TxDOT. In a survey, 80 percent of respondents indicated that the My35 emails were useful; 90 percent said they were easy to understand; and 88 percent said the emails contained the right amount of detail. The dynamic message signs were deemed useful/helpful by 83 percent of respondents, with 88 percent saying the signs displayed destinations that were important to them.

An unexpected positive impact was that requiring contractors to report lane closures a minimum of 7 days in advance (to facilitate preparation of the construction overview e-mail newsletter) has helped TxDOT coordinate the project across the various sections and contractors. Because TxDOT approves closures on a first-come, first-serve basis, contractors who submitted early found that they were better able to organize their own work and resources.

TxDOT's safety and communication measures were so effective in reducing accident levels that the agency has begun to implement them along normal roadways where there is no construction. As a result, the I-35 ICM project has proven a useful test-bed for systems that have wider applicability to the state's roadways.

Finally, the benefits of the data gathering and predictive models will impact projects well into the future, and in areas beyond this segment of the I-35 corridor. "The system is transferrable," Ms. Wheatley explained. "It can also incorporate information from other sources. The whole idea behind developing the predictive analysis is that it can be applied anywhere."

"This is a work in progress. We're figuring it out as we go along, and seeing what works and what doesn't work, and what has an effect and what doesn't have an effect. This is all a giant information-gathering process from the standpoint of how we do better in the future."

Jodi Wheatley,
Spokesperson,
TxDOT

## Lessons Learned / Next Steps

According to Ms. Wheatley, the initial challenge of the I-35 ICM Project was starting from scratch to create an information dissemination network. Reaching all drivers has been a challenge. Because the local media was not always cooperative in broadcasting the necessary project information, Ms. Wheatley started an email list to get information out, focusing on the most influential entities in the public sector sphere – "anybody that I could think of that might have had a wide database of people or companies on their own list," she said. A database was created so alerts and information could be automatically updated, and then a self-subscribe function was added for the email list. According to Ms. Wheatley, extreme weather in 2014 also generated a lot of word-of-mouth about the closures. The subscription numbers don't reflect accurately how many people know the situation, since many people learn second- or third-hand from subscribers.

An ongoing issue that cannot be addressed through a local partner network is that roughly a third of traffic through the area consists of long-haul trucks. Even within the project, news coverage tends to be very local, so people traveling across multiple sections of construction may not receive information about all the closures and alternate routes for their journey. To address this problem, Ms. Wheatley is relying on traditional, low-tech messaging. "We're trying to work up funding for a billboard campaign to say, 'Need information on lane closures? Go to my35.org,'" she said. "The single biggest problem all along has been letting people know there is a way they can get information – getting that first piece of information out to them."

Ms. Wheatley indicated that the most important consideration during the project has been to collaborate with technological expertise, but to remain customer-conscious in messaging and delivery. "The focus for me has been to ask myself, 'What serves the driver best?' Sometimes it goes all the way from how we get them information, to the way things are phrased. The message that goes out needs to be easy, tailored to what they need, and done with them in mind."

As for future efforts, TxDOT is collecting and analyzing data from monitoring stations and radar to build predictive models. Agencies in Houston and those working on other segments of interstate construction in Texas are using the I-35 ICM data to work toward predictive models for their own areas and projects. According to Ms. Wheatley, the I-35 ICM Project is not merely a way to discover how to improve this single project, but how to implement the benefits in the future. "This is a work in progress. We're figuring it out as we go along, and seeing what works and what doesn't work, and what has an effect and what doesn't have an effect. This is all a giant information-gathering process from the standpoint of how we do better in the future."

## More Information

For more information, please visit http://www.my35.org

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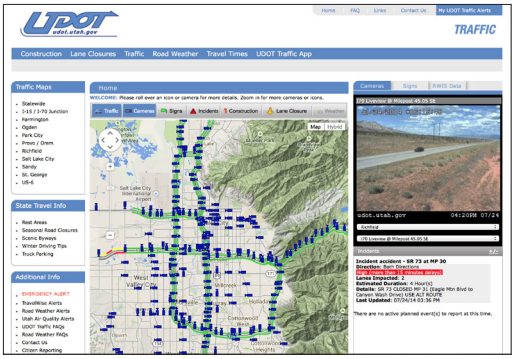
# UDOT Uses IoE Capabilities to Improve Traffic Flow and Road Safety, Reduce Fuel Costs and Emissions





## EXECUTIVE SUMMARY

### Objectives

- Preserve infrastructure
- Optimize mobility
- Strengthen economy
- Reduce road fatalities

### Strategy

- Established network of partnerships with municipalities, state agencies, and private companies to enable innovation and ability to serve citizens more effectively
- Developed app that especially targets rural residents, encouraging them to crowdsource updates regarding conditions on roads that UDOT does not electronically monitor

### Solutions

- Fiber-optic network infrastructure
- Advanced traffic management system, including traffic cameras, variable message signs, traffic detectors, weather stations, and the UDOT traffic website and mobile app

### Impact

- Better visibility into Utah's transportation systems
- Faster, more efficient traffic management
- More timely infrastructure repair
- Improved traffic flow and road safety; reduced fuel costs and CO2 emissions; faster commutes

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About UDOT

The Utah Department of Transportation (UDOT) combines connectivity, technology, and data analytics to increase efficiency and lower costs. Programs include road and traffic-flow monitoring; regional traffic-information sharing and traffic-flow coordination; development of a software interface that maps and organizes layers of GIS data; and the use of Lidar to collect real-time 3D data of roads and highways.

Carlos Braceras was appointed executive director of UDOT following stints as UDOT's deputy director, chief engineer, and region director. He has served as the state's chief geotechnical engineer, chief value engineer, and roadway design engineer. In 1998, he was named "State of Utah Governor's Manager of the Year" and received the "UDOT Leader of the Year" award.

David Burton is UDOT's information technology director; Robert Clayton is UDOT's traffic management director; John Thomas serves as UDOT's planning manager; and John Gleason is UDOT's public information officer.

The Utah Department of Transportation (UDOT) combines connectivity, technology, and data analytics to increase efficinecy and lower costs.

## Objectives

Four strategic goals guide UDOT's planning strategies: 1) preservation of infrastructure, 2) optimization of mobility, 3) strengthening the economy, and 4) zero road fatalities.

UDOT's innovations in transportation and infrastructure management include the following:

- **Traffic Signal Monitoring System:** allows remote access for monitoring and adjusting timing of 80 percent of the traffic signals throughout Utah
- **Traffic Signal Automated Performance Measures Program:** provides real-time measurement and analysis of traffic signal performance to inform signal adjustment and improve traffic flow
- **UPLAN:** incorporates GIS mapping with thousands of layers of information for planning purposes
- **Traffic camera system:** informs UDOT, public safety agencies, and the public about traffic congestion and incidents
- **Lidar imaging:** enables remote viewing of entire road and environmental structures to educate planning and pinpoint maintenance needs
- **Public crowdsourcing system:** gathers road condition reports in rural areas
- **Fiber-optic network:** used by the agency and leased to private and municipal entities
- **Freeway electronic message signs**
- **Partnerships with technology firms and municipalities:** enable optimization of technology and integrated systems for efficient planning and upkeep

## Strategy

The core of UDOT's strategy is a network of partnerships with municipalities, state agencies, and private companies. UDOT believes that leveraging partners allows the organization to innovate and serve the citizens of Utah more effectively. "As a public agency, our focus is on the outcomes we are trying to achieve," Mr. Braceras explained. "The more we can leave the 'how' to our partners in private industry – even just leaving the how-to with our employees within the department – it's amazing the type of innovation that occurs."

UDOT has opened up its real-time traffic and road monitoring data through a free mobile app and website. The app has been particularly popular, with 250,000 downloads in a state of about 3 million residents.

For example, handing analytics work to technology companies has yielded more creative, insightful models than would have been possible if they were developed in-house. Partnering with tech companies has also allowed UDOT to beta-test new technologies within the tech company before they are rolled out for public use. According to Mr. Braceras, opening public processes to private competition reduces costs, inspires innovation, and accomplishes the goals of the state in a far more effective way than public resources alone. "Our job is truly about safety, mobility, preservation of the infrastructure, and helping the economy," he said. "I prefer private sector to come in, because I want to see competition and innovation. Competition brings innovation. As soon as you get down and you start thinking you know how to do something, you start losing the ability to take advantage of what other private sector competition can bring. I think as a public agency, it's about keeping yourself focused on what you're trying to achieve."

Partnering with other public sector agencies such as municipalities on projects like the Traffic Signal Monitoring System allows both entities to retain ownership over infrastructure, but with an agreement to cede operation during special circumstances. According to Mr. Burton, the public has been receptive to the improved operations because of the joint ownership.

Finally, UDOT also works directly with the public, providing and collecting data to improve the driving experience. First, UDOT has opened up its real-time traffic and road monitoring data through a free mobile app and website. The app has been particularly popular, with 250,000 downloads in a state of about 3 million residents. "We've got pretty good penetration," says Mr. Clayton. "People really like the app. It's a good way for us to communicate."

UDOT also developed an app that especially targets rural residents, encouraging them to crowdsource updates on road and travel conditions on mountainous roads that UDOT does not electronically monitor.  Utah experiences heavy snows in the winter, especially in mountainous areas of the state. In these areas, UDOT cameras are not installed with the same density that they are in urban areas. Through the app, rural residents can share with one another and the department important information about road conditions and safety. In its first year, more than 500 users participated, providing a vital link between the agency and the public.

UDOT also conducts statewide public service campaigns promoting safe and smart travel habits.

UDOT relies on the state's Transportation Commission and state legislature for its annual budget. Some of the software collaborations, however, have come at no cost to UDOT, such as cases where software companies own and test their own products.

UDOT owns its fiber-optic system, but allows use of its installed ducts by private companies, while private companies have also allowed UDOT to expand its network on private fiber-optic lines. UDOT also owns its traffic cameras, but has allowed media companies to tap into the live footage for traffic-related and other media broadcasts.

UDOT's advanced traffic management system (ATMS) includes traffic cameras, variable message signs, traffic detectors, weather stations, and the UDOT traffic website and mobile app, which provide data to UDOT, emergency officials, media organizations, and the public on the Internet.

## Solution

### Fiber-Optic Network

The core of UDOT's system is its fiber-optic network. After laying the first cables 15 years ago, the department built up capacity piecemeal on an as-needed basis for various projects, and coverage was spotty. Ten years ago, UDOT realized a better long-term approach would be to dedicate a project to networking Salt Lake County (the most populous county in the state and home of the state capital and county seat, Salt Lake City). UDOT did not know how much capacity it would need in the future, so a portion of empty ducts were installed during a major rebuild of I-15, the primary north-south roadway through the county.

The infrastructure was then made available for private businesses to lay cable to bring Internet service to the community, while UDOT maintained control of the cable system. "We never would have that reach if we didn't just adopt this philosophy that we are going to partner with private industry and realize that it is OK to have a private company with their own fiber right away," said Mr. Braceras. "There are a lot of DOTs [Departments of Transportation] that do not want that. They do not want anyone in their road. But it's not our road, it is the public's road, and we are going to leverage the public's value here." The private partnership trading led UDOT to now control more fiber than it installed itself, so the UDOT system has more than doubled.

### Advanced Traffic Management System

UDOT's advanced traffic management system (ATMS) includes traffic cameras, variable message signs, traffic detectors, weather stations, and the UDOT traffic website and mobile app, which provide data to UDOT, emergency officials, media organizations, and the public on the Internet. Cameras show traffic conditions on major roadways, as well as weather conditions and incident information.

### Traffic Signal Monitoring and Measuring

UDOT has connected nearly 80 percent of the state's 1,900 traffic signals on its fiber-optic network; four out of five of these signals are owned by UDOT, and the remainder by individual localities. A single software application manages all of the signals, which allows for seamless communication and coordination across all of the signal owners. "We invested. We bought the controllers, the computers, the chips, and basically upgraded the local signals so we could be all talking together," said Mr. Braceras. Having signals coordinated across jurisdictional boundaries is especially

useful to move traffic efficiently during big-event situations such as college football games, in which UDOT is given authority over localities to manage signal changes.

UDOT's Traffic Signal Monitoring System gives the department unprecedented control to dynamically manage traffic. First, a controller housed in a roadside cabinet – one for each traffic light – dictates when the light should change based on traffic conditions in and around the intersection. In addition, each signal feeds real-time data to UDOT regarding arrival times of vehicles when the light is green and red, the wait times at red lights, and equipment functionality, such as if a pedestrian-crossing light is broken.

Signal timings require human adjustments, but rather than doing them in the field, engineers can make the improvements to traffic patterns from their desks or even in the field – anywhere they have Internet access.

UDOT also uses radar to monitor traffic on roadways. Data from the radar system feeds into the system, telling lights when a car is waiting. Previously, UDOT heavily utilized "loops" embedded in the roadway to sense traffic, but recent innovations led UDOT to transition to the radar devices on poles because the loops were less flexible and invasive to the pavement (installation of the embedded loops required cutting into the roadway, where water could easily damage the pavement around the loops). Pole-mounted radar is easier to maintain, and the system provides more accurate data because bicycles, motorcycles, and pedestrians are now detectable.

This data from the traffic signals is then analyzed by UDOT's Traffic Signal Automated Performance Measures Program to understand the effectiveness of signal timing. Signal timings require human adjustments, but rather than doing them in the field, engineers can make the improvements to traffic patterns from their desks or even in the field – anywhere they have Internet access. According to Mr. Burton, "It used to be that independent boxes would gather statistics, and that information would be processed over weeks or months. Then, data was fed back into the timing changes of the signals, meaning possibly weeks of delay before traffic flow could be improved. Now, improvement occurs in real time. If they see an issue, they can literally change the timing in real time."

## Traffic Camera System and Lidar

UDOT also has more than 900 cameras on its fiber-optic system statewide to monitor traffic and road conditions. These cameras feed traffic flow and other data to UDOT, public safety, and emergency officials so dispatchers and first responders can quickly access and relay accurate information to emergency responders. A mobile traffic application provides general access to the traffic camera data feeds, as well as weather forecast information, road temperatures, and lane-closure information. The information is available to the public on udottraffic.utah.gov.

UDOT also uses Lidar 3D images to aid in planning and infrastructure maintenance. In order to gather the data, a Lidar-equipped vehicle will drive down the roadway with a unit that sends 64 lasers out and collects 2,000 points of data per second. This provides an incredibly detailed 3D image of the surrounding natural and built environment, all seen with design-level accuracy.

UDOT is additionally working on utilizing Lidar to further improve its ability to plan and manage Utah's roads. This includes the ability to see 3D road images that pinpoint maintenance needs and give precise geographical data for planning and development purposes.

## Electronic Messaging System

According to Mr. Clayton, UDOT has 150 variable message signs across the state, and more than 530 traffic-monitoring stations. The monitoring stations are mostly radar devices attached to poles that measure speed and vehicle counts along the roadways, with the ability to classify the types of vehicles using Utah's roads. The monitoring stations allow travel time to be reported via UDOTs website, mobile app, and variable message signs.

The UPLAN platform is made available online, allowing UDOT to easily share data with contractors and other interested parties. Since being made public, the platform has been adopted or modified by 37 states.

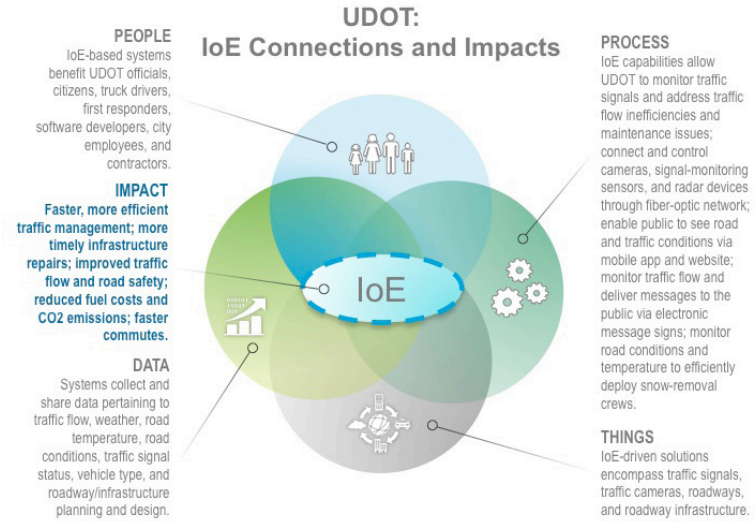
## Weather Stations

UDOT owns 85 road weather stations statewide that deliver critical information during storms and allow UDOT officials to see road conditions in real time. These stations also assist UDOT in creating weather forecasts to help plan for maintenance crew deployment to clear snow or lay salt. The weather stations measure the temperature of the roads so UDOT knows which treatments to apply. This weather information is also made available to emergency responders so that they can anticipate possible accidents or other emergencies.

## UPLAN

UPLAN is an interface system that merges thousands of layers of shared GIS-based information, which UDOT consults for planning purposes. It was developed in collaboration with more than 30 software companies and technology vendors. The collaboration began several years ago when UDOT invited its software vendors to a meeting to discuss problems UDOT was having in trying to get the various software systems to communicate with each other. According to Mr. Braceras, this meeting immediately resulted in some of these vendors starting to work together to figure out how to make an interoperable platform for the various GIS data feeds. The UPLAN platform is made available online, allowing UDOT to easily share data with contractors and other interested parties. Since being made public, the platform has been adopted or modified by 37 states.

**Figure 1.** UDOT: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

According to Mr. Braceras, UDOT's technological initiatives create a highly granular understanding of Utah's transportation systems. This data is of extreme benefit in both the daily management of the roadways and in the infrastructure planning process. Making this information accessible both publicly and remotely adds an even greater level of usability, which has helped the agency achieve its goals of preservation of infrastructure, optimization of mobility, strengthening the economy, and reducing road fatalities.

### Just-in-Time Road Maintenance

Specifically, improved understanding of the condition of infrastructure assists in making timely repairs. This supports the organization's goals of increased mobility and safety by reducing the time required for road and lane closures, which increases traffic flow, contributes to road safety, reduces fuel costs through decreased idling, and speeds up commutes.

UDOT's technological initiatives have contributed to fast and efficient traffic management as well. Sudden changes in traffic patterns due to landslides, accidents, storms, and large events can be monitored and managed remotely from any device with Internet access and credentials.

### Improved Traffic Flow

UDOT's technological initiatives have contributed to fast and efficient traffic management as well. Sudden changes in traffic patterns due to landslides, accidents, storms, and large events can be monitored and managed remotely from any device with Internet access and credentials. If UDOT sees an obstruction on a freeway, information is fed to Ports of Entry so that long-haul trucks can be rerouted, saving time and money for the shipping companies and businesses waiting for deliveries. Commuters also have quick access to real-time traffic and road conditions via the UDOT mobile app and website for more efficient travel and contingency planning.

Furthermore, with the Traffic Signal Automated Performance Measures Program, UDOT can remotely view signal reports and make adjustments to the signals, helping to decrease time spent accelerating and idling at intersections, increase traffic flow, and reduce the chances of rear-end crashes and the running of red lights. According to Mr. Clayton, most agencies retime signals every three to five years, but UDOT's program allows it to easily identify the locations that need signal timing adjustments first. Time and fuel savings for drivers are another benefit of the SPM Program. According to Mr. Clayton, a recent implementation on Bangerter Highway and Foothill Drive allowed UDOT to upgrade the signal timing plans, allowing it to achieve improvements of between 15 percent and 25 percent for "arrivals on a green [light]." According to Mr. Braceras, well-managed traffic flow contributes to the local economy and has an environmental impact as well through reduced carbon emissions.

### Effective Data Sharing and Reporting

UPLAN has revolutionized UDOT's data-sharing capabilities, both for the general public and for outside jurisdictional use and agency projects. Rather than relying on old methods such as emailing data and trading flash drives, the agency can now make data available with the click of a mouse. "If Carlos [Braceras] has some data, he publishes it and makes it available to the world or to one person. He has the

ability to structure that," said Mr. Thomas. "I can search for 'Carlos's data' and it will respond with all of Carlos's data, all with one click."

Lidar's ability – like that of UPLAN – to organize and access data simplifies and speeds up required reporting, such as environmental impact reports. A recently produced environmental impact statement was completed in three weeks rather than the several months previously required for the task.

In addition, feeding detailed data into the planning of transportation construction projects allows contractors to make more accurate bids, decreasing both financial risk for the contractors and, consequently, their bid prices. This, as Mr. Thomas noted, saves taxpayer money.

Utah has also found success in partnering not just with the private sector and other local agencies, but with individual citizens as well: its crowdsourcing app allowed rural residents to report on road conditions in places not reached by the fiber-optic network.

### Public-Private Cooperation

Due to UDOT's forward thinking in laying empty ducts during the reconstruction of the I-15 interstate highway, the infrastructure was available for private businesses to bring Internet service to unserved communities.

According to Mr. Burton, innovation through technology also broadened the field of potential contractors and lowered project costs. "The competition's going up, too, with the way that we bid out our projects. It used to be more of a local bidding process, but now that's pushed out beyond even the state boundaries due to the Internet accessibility of bid information, so a greater number of competitors can bid on UDOT projects."

## Lessons Learned / Next Steps

According to Mr. Braceras, the most important lesson learned is the importance of trusting in cooperative relationships with developmental partners. This has been crucial to meeting department goals, whether planning fiber networks, partnering with municipalities over traffic signal control, or bringing software companies together to find solutions to problems. "When you see successful organizations working together it's about relationships," he said. "It's the difference between relationships between people versus the relationships between data. It's the same thing. The better your personal relationships, the better your data will be shared among many different people, many different organizations, for better outcomes."

Utah's size – large enough for a sufficient development budget but small enough for limited bureaucracy – and its reputation as a sound development partner make the state ideal for private sector development and testing. "Utah is a perfect petri dish for companies that want to innovate and try out technologies because of that unique mix," said Mr. Burton.

Utah has also found success in partnering not just with the private sector and other local agencies, but with individual citizens as well: its crowdsourcing app allowed rural residents to report on road conditions in places not reached by the fiber-optic network. "Collaboration is truly the solution in solving the problems that we deal with today," he said. "Solution crowdsourcing draws on that knowledge base to solve these problems."

UDOT is leveraging its current technologies with newer developments like Lidar to link planning and design more closely to operational data. “The evolution that’s taking place is that data for planning can be data for design,” Mr. Burton said. “We’re now working towards doing 3D design, not just 2D design. We’ve had projects where contractors will take the design information, create a digital training 3D model, and feed it into their equipment. Where we’re going is the 3D design will now be taken directly. The contractor will use that, feed that into their equipment. We do not have to go out and gather our own data for each functional unit; we’re all using the same data throughout the workforce.”

According to Mr. Burton, embracing innovation and leveraging partnerships will allow UDOT to improve efficiency and delivery in the future. “Right now, we’re again on the cusp of being able to take another innovative leap. We have this information, and now we’re starting to analyze it and see what it tells us so we can understand how we can improve our decision-making processes to make the next one.”

## More Information

For more information, visit http://www.udot.utah.gov/

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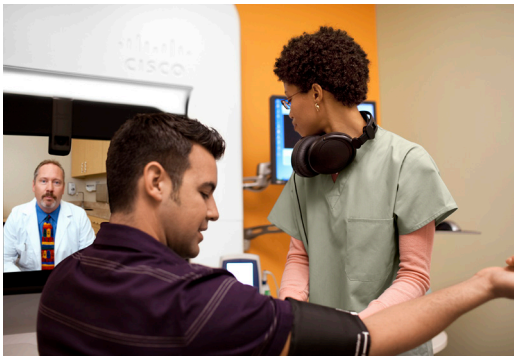
# UVA Center for Telehealth Uses IoE Capabilities to Extend Quality Care to Medically Underserved Areas



**EXECUTIVE SUMMARY**

### Objective

- Provide timely access to specialty medical services that are otherwise unavailable in communities throughout Virginia and around the world

### Strategy

- Locate strong advocates and leaders during program development
- Partner with a competitive variety of vendors to help address budget challenges
- Continue developing data analytics to identify ways to refine and streamline care delivery

### Solution

- Using video and remote medical equipment, UVA Center for Telehealth provides basic medical examinations and services in 40 specialties, including psychiatry, cardiology, pediatric specialties, child neurology, orthopedics, and genetic studies

### Impact

- Telemedical services stretch healthcare resources; save money, time, and travel; accelerate healthcare delivery; increase access to specialty services; and provide educational training opportunities that assist physicians both locally and internationally
- UVA Center for Telehealth is now approaching 40,000 clinical encounters in 40 different disease specialties over 125 sites in Virginia, saving citizens of the Commonwealth 8.9 million miles of travel

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About UVA Telehealth

The University of Virginia is a pioneer and leader in regional, national, and international telehealth programs. As well as serving patients throughout Virginia, the UVA Center for Telehealth has expanded its programs to the medically underserved in Latin America, the Caribbean, Africa, and other international destinations.

Using video and remote monitoring equipment, the UVA Center for Telehealth has provided more than 40,000 encounters, offering basic medical examinations and services in 40 specialties, including psychiatry, telestroke cardiology, pediatric specialties, infectious disease, child neurology, orthopedics, and genetics. The UVA Center for Telehealth is headquartered within the UVA Medical Center and is a component of the University of Virginia Health System.

David Gordon is director of the UVA Office of Telemedicine, where he also serves as director of community engagement and rural network development. A native of Central Appalachia, Mr. Gordon was raised in the coalfields of Southeastern West Virginia. He is a community organizer by training, with advanced degrees in divinity and social work. He is co-director of the Healthy Appalachia Institute, and a member of the American Telemedicine Association, the National Association of Social Workers, and a board member of the Mid-Atlantic Telehealth Resource Center. Mr. Gordon is also an instructor in public health sciences and nursing at UVA.

Brian Gunnell is a video conference network engineer and analyst for the UVA Center for Telehealth. He previously worked for Albemarle County Public Schools as an audiovisual specialist, and is general manager of GCC Productions.

## Objectives

The UVA Center for Telehealth began in the mid-'90s following a medical procedure performed at the UVA Medical Center on a member of the Saudi royal family, and the ensuing press coverage of the event, including the long-distance care plan established by physicians. "The president of the university in his annual report told the story of how we were connecting to Saudi Arabia," Mr. Gordon remembered, "and it wasn't but a little time later that a legislator from Far Southwest Virginia picked up the phone and said, 'If you can go to Saudi Arabia, you can go to Pound, [Virginia]. If you can take care of a Saudi princess, you can take care of a kid that lives in a coal-mining community in Southwest Virginia.'"

Mr. Gordon described what followed that initial phone call as a coordinated effort to ensure the commitment of physicians, obtain funding, install a telecommunications infrastructure, and provide telemedicine education to the community of providers in medically underserved regions of rural Virginia. "Initially, we were really founded with community-based clinics, small rural hospitals, health systems, health departments, community services boards. When they had an identified need, they'd reach out to us, and we'd reach out to them. We looked for grant dollars together, and we'd help them set up a telemedicine capability. We'd start testing, we'd put together a protocol and start seeing patients.

"It's about the network of technology," Mr. Gordon continued, "but it really is about the network of people: the physicians, scientists, researchers, community members,

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David Gordon,
Director,
UVA Office of Telemedicine

 

patients. In that, we really feel like we've made gains. From the get-go in '95, we were really designed to be a program that first and foremost reached out to the community where services were otherwise unavailable. We've got the commitment of champions at UVA, we got the commitment of champions in the community, and so those two things became the foundation for what we've become."

## Strategy

Mr. Gordon sees telemedicine as an effective way to stretch medical resources due to its potential for influencing the way medicine is practiced at every level. "It's your connection to a referring physician," he said. "It's what you do in conference rooms, and what you do on the desktop. It's what you do on your mobile phone. It's what you do educationally, and it's how you share a Grand Round (an important teaching tool in the medical profession) and the intellectual property there. When you talk about what telehealth is now becoming in a system, it has to become integrated into all of those elements."

The UVA Center for Telehealth is also expanding its services to international medical communities, providing mentoring and training in medically disadvantaged communities in Africa, Latin America, the Caribbean, and other areas that are resource-challenged.

In order to provide telemedicine services to local rural areas, the UVA Center for Telehealth enters into detailed agreements that are compliant with CMS conditions of participation and JC standards with those hospitals and health clinics that want to partner. The agreements allow these clinics to connect with and draw upon the expertise of doctors and specialists at UVA. "We make the arrangements that are specific to the kind of clinical care that we would be providing to that hospital, such as a stroke agreement or an endocrine clinic or a neonatal agreement," Mr. Gordon explained. His office has formed agreements with 125 community partners that run "from the eastern shores of Virginia all the way to Lee County, which is farther west than Detroit, Michigan. It is a huge geography that we operate within," he stated.

The UVA Center for Telehealth also offers its services within the UVA Medical Center. Physicians can consult with one another and share documents to get immediate opinions and assistance, instead of having to physically move about the hospital, which is disruptive to their work and reduces productivity. From Spanish teleinterpretation services to video consultations and virtual meetings for executives, Mr. Gordon and his colleagues continue to explore ways to optimize patient care and contribute efficiency to the work of UVA's many professionals.

UVA Center for Telehealth is also expanding its services to international medical communities, providing mentoring and training in medically disadvantaged communities in Africa, Latin America, the Caribbean, and other areas that are resource-challenged.

As part of the UVA Health System, the UVA Center for Telehealth receives funding for its domestic and international programs from a variety of sources, including university funds and external grant funds, the Virginia Tobacco Settlement, and funds from institutions such as the Clinton Global Initiative. The organization also received a large amount of funding in 2010, when the Virginia General Assembly unanimously passed mandated coverage for telemedicine through state Medicaid. The center also receives funding from Medicare, Virginia Medicaid, healthcare grants from the USDA, and other state and federal government grants.

 

UVA Center for Telehealth generates revenue through several significant clinical contracts, including one with the Department of Corrections.

Mr. Gordon explained the fiscal policy of the Center: "It's been very important for us to bring in revenues because you need to show folks that this is a zero-sum game and beyond. We have certain charges with all of our partner sites. There's a nominal but important contractual relationship that allows us to maintain that connection and support. Then, of course, because we can build for the physician encounters, we have a master agreement between the physician practice and telemedicine that has us receive a small piece of every clinical encounter." He estimates the revenue from clinical encounters at approximately $1 million per year.

Mr. Gordon emphasized that the office carries its expenses through its own revenue sources. The administrative costs of the UVA Center for Telehealth remain relatively modest – roughly $700,000 per year, according to Mr. Gordon. "That's just a day-to-day operational thing and doesn't include all the expense of the network. That's just our centralized service," he said.

"We are very proud of our global program. Our technology team here developed a portal-testing process so that we could go into countries in Africa and Central America and the Caribbean, around the globe, and be able to test networks, check up-and-down speeds, look at various connectivity tools, and find ways to connect and then develop relationships and systems."

David Gordon,
Director,
UVA Office of Telemedicine

## Solution

The telemedicine services offered by the UVA Center for Telehealth provide increased opportunities for medical services throughout Virginia and in many underserved areas of the world. Services range from clinical consultations, medical education for providers and patients, and many local and international outreach projects.

Mr. Gordon described his office's training program in these international partnerships. "Today I had a long conversation with a neurosurgeon here who is developing rounds in Rwanda, where we already do surgical rounds and anesthesiology rounds. He wants to do neurosurgical training," said Mr. Gordon, emphasizing the need by adding that the country currently has two practicing neurosurgeons for the entire population.

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Physicians within the UVA Medical Center are also beginning to adopt telecare technology while treating patients within the UVA complex. In the past, doctors would scrub out of a surgery to provide an urgent consultation, leaving the surgery to an associate to finish. Now, they can receive a high-resolution image of the issue on their iPad using collaboration technology, and respond without having to leave their own work. "We've seen this remarkable change so that telemedicine is now an inside-outside expansion," said Mr. Gordon. "We are growing as fast on the inside now as we are growing on the outside."

Mr. Gordon is particularly impressed with the way patient services and administrative encounters have expanded with the proliferation and acceptance of the organi-

 

zation's unified communications system, which features voice, IM, presence, voicemail, and conferencing. According to Mr. Gunnel, "We started with about 20 users on that. We're sitting at just under 200, and we're anticipating over the next three to four months that is going to blossom up to about 600." Mr. Gunnel expects this to swell to roughly 3,000 users in the next two to three years due to its ease of use and data security.

"[Our equipment provider] has been very good about the open architecture, allowing us to interact with all the different flavors of equipment that are out there. It's quite challenging. You have a clinic that's holding on to, say, [a teleconference bridge] that they've been using for eight or nine years, and it still works, but the quality is not that great. So we have to make sure we can accept those types of older, legacy systems into our infrastructure, and that they communicate very easily with all of the current equipment that we have."

Brian Gunnell,
Video Conference Network Engineer and Analyst,
UVA Center for Telehealth

## Teleconferencing

Mr. Gunnell explained his objectives in choosing technology for the many sites he services: "We focus very hard on trying to make this as simple as can be for the doctors, and what I like to say is the technology needs to fall away and really become not part of the situation. It's really about that interaction between the doctor and the patient or whoever's on the screen. In doing that, you have to make the equipment very easy to use, but it's a fine line between being easy and being secure, and obviously in a medical environment we have to really focus on the security in the encryption between these pieces of equipment."

UVA Center for Telehealth uses telepresence bridges that can interface securely with a variety of equipment. "[Our equipment provider] has been very good about the open architecture," Mr. Gunnell explained, "allowing us to interact with ... all the different flavors of equipment that are out there. It's quite challenging. You have a clinic that's holding on to, say, [a teleconference bridge] that they've been using for eight or nine years, and it still works, but the quality is not that great. So we have to make sure we can accept those types of older, legacy systems into our infrastructure, and that they communicate very easily with all of the current equipment that we have."

According to Mr. Gunnell, minimum levels of data transfer are established by the regulating body, the American Telemedicine Association, per clinical specialty, but are sometimes limited by remote equipment. "Typically, we like to try to get up around 1 megabit [per second] now for the connections, but it really depends on what specialties we're looking to do and what's available," he explained. The minimum for neurological encounters is 512 kilobytes or better, and for high-definition encounters, the minimum acceptable speed is 712 kilobytes for uploading and downloading.

## Peripherals

"We use a big variety of peripherals at this time," Mr. Gunnell noted, including digital stethoscopes, otoscopes, patient cameras. "The stethoscope is a pretty important piece, as well as having a handheld camera that you can hook into the codecs," Mr. Gunnell continued. "We have some doctors who are really just getting into telemedicine, so this is the first couple of times they've used the technology. With the stethoscope this morning, [one doctor] came out of the room and he actually said he thought he could hear it better over our system than he could in real life, face-to-face with the person."

According to Mr. Gunnell, movable camera technology also figures prominently into patient encounters. "Most of the time, these fixed endpoints have cameras that are PTZ, or pan-tilt-zoom, but what we find is also having a handheld camera in

 

the clinical spaces makes it easier to get shots of different things. If you're doing wound care, it may be hard to zoom the camera in to get the right angle, so having a handheld camera there hooked into the endpoint makes it easier to identify wound care or burns," he said.

## Data Management

Mr. Gunnell explained that he has developed a "technical dashboard" for back-end data tracking and analytics. "There was a large amount of clinical data being collected, but what we started to do was look at numbers of connections. We started to look closer at how long connections would be made, [and] response time."

In addition, Mr. Gunnell has begun tracking data in an SQL database, including data from the call logs for the emergency response system, patient data, inventory, and equipment. "We've created a very robust database, so [for example] we can look for a particular clinic in Southwest Virginia and see what equipment they have, and get the specific information we need to troubleshoot that site," he said.

"We've created a very robust database, so [for example] we can look for a particular clinic in Southwest Virginia and see what equipment they have, and get the specific information we need to troubleshoot that site."

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Mr. Gunnell noted he is still in the process of analyzing the large amounts of data being collected. This is particularly useful for the telestroke program, which receives calls around the clock. "We [became] more interested in quality metrics on how the calls were going. We were very interested in how much usage any particular endpoints were getting for clinical usage," he said. Mr. Gunnell eventually chose a data management partner whose solution "pulls [backend data] into a pretty nice format. It's a tremendous amount of data, but it taps essentially every one of our systems and organizes it into a nice, clean space for us," he said. Mr. Gunnell explained that the program also alerts him when there is a large amount of packet loss across certain connections, a situation that might compromise the quality of a video conference.

## Technology Partners

Mr. Gunnell explained some of the forces affecting the preferred technology: "What we're finding is we're really having a lot of pressure pushing us toward the desktop and mobile solutions, because that's where everybody wants to go. They want to be on the move, they want to be able to make these connections from everywhere out in the wild. We still lean on fixed endpoints in our clinical spaces, but it's really starting to drive toward the more mobile technology, and getting people more flexibility on how they dial into the systems."

In addition to their main telemedicine infrastructure provider, Mr. Gunnell explained that his office routinely partners with a range of technology companies, and continues to research all available options to optimize patient encounters, reduce costs, and assist with administration. "We work closely with several different companies," he stated. "We've been looking closely recently at a couple of different services that are like a new bridging service but work like an MCU. They go down to mobile phones. We've been talking to a couple of partners that operate in that environment that really focus on the whole WebRTC," he said.

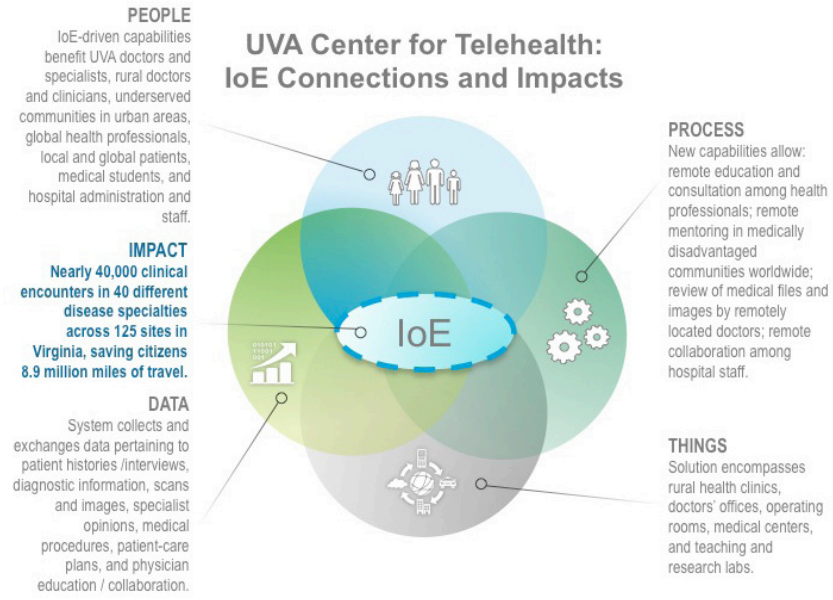
Mr. Gunnell and his two colleagues on the office's technical team continue to research and incorporate the most effective and cost-efficient technological options.

“As a tech team, we really pride ourselves in trying to stay on top of what’s out there, the new stuff that’s coming,” he said.

According to Mr. Gordon, since its founding in the mid-’90s, UVA Center for Telehealth is “now passing 40,000 clinical encounters in 40 different disease specialties in more than 125 sites in Virginia, saving citizens of the Commonwealth 8.9 million miles of travel.”

**Figure 1.** UVA Center for Telehealth: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

UVA Center for Telehealth is routinely cited in the press as a model for other telemedicine programs. According to Mr. Gordon, Virginia’s Center for Innovative Technologies routinely selects Virginia as the top provider of telemedicine in the nation. UVA Center for Telehealth recently agreed to become an academic partner of Specialists On Call, one of the largest telestroke care providers in the world. Mr. Gordon stated, “We are now their academic partner in terms of research, continuing education, as well as being a provider in Virginia. They have the relationship with the hospital, and it is our UVA doctors providing their clinical expertise through the Specialists On Call network.”

UVA’s telemedical services stretch healthcare resources and save money, time, and travel. According to Mr. Gordon, since its founding in the mid-’90s, UVA Center for Telehealth is “now passing 40,000 clinical encounters in 40 different disease specialties in more than 125 sites in Virginia, saving citizens of the Commonwealth 8.9 million miles of travel.”

Increased speed of delivery is another advantage. Mr. Gordon explained, “In our telestroke program, for example, we’ve been able to successfully put into place all the process protocols, clinical protocols, and technical protocols, with technical coverage and CT movement through the PACs system – getting the doctors on board, looking at the patient, a tech who’s standing ready in a system that we make sure that, in our opinion, is always operational. We’ve been able to get that down to under a 10-minute operation to have those things happen.”

Providing increased access to specialty services is another benefit of telemedicine. Mr. Gordon described UVA Center for Telehealth's psychiatric services as an example. "We've become a resource for children and families throughout the state, as we do adult and child psychiatry through services to community services boards, hospitals, as well as emergency psychiatry. We'll probably do 3,000 encounters this year alone in child psychiatry. We see it as a continuing, important place to grow not only externally to community hospitals, CSBs, but also internally to our family practice doctors. These are important directions in which we are heading."

In addition, UVA Center for Telehealth's educational training opportunities assist physicians both locally and internationally. They are involved in many programs, and their physicians provide medical mentoring in areas often badly in need of medical support. Mr. Gordon and Mr. Gunnell mentioned examples of training in neurosurgery to support the two practicing neurosurgeons in Rwanda, along with a training program in remote areas of Guatemala.

"In this day and age of the Affordable Care Act, we need to reform to be more efficient. We're going to change our relationship of where we go, so our connections are going to expand from clinics and hospitals to homes, to places of work, to schools."

David Gordon,
Director,
UVA Office of Telemedicine

Mr. Gordon expressed his belief that the objectives of telemedicine fit well with the recent changes in healthcare coverage, providing convenient, safe, and cost-effective care options by bringing medicine to the patient and reducing the administrative load on the doctor's office. "In this day and age of the Affordable Care Act, we need to reform to be more efficient. We're going to change our relationship of where we go, so our connections are going to expand from clinics and hospitals to homes, to places of work, to schools."

Mr. Gordon indicated there have been unique patient benefits as well. "We had a patient who came in with a neurological incident, and her only child was getting married the next day. She had been planning his wedding for a year," he stated. "We were able to get the son to download our unified communications software onto his laptop, and we set up the cart in her room with the big screen. She was able to be on the receiving line and watch the wedding. That's what it's all about."

Mr. Gordon offered his perspective on the broad potential of telemedicine: "I'm a community-based public health person, and I see within it the possibilities for community health and wellness. It pulls on my heart, not just my intellect or my pocketbook, to know how important this is when you've seen a patient recover function after a stroke, or you've seen a child who has an interrupted aortic arch get medicine and live as a result of what we can do with this."

## Lessons Learned / Next Steps

Mr. Gordon said that dealing with significant growth remains his biggest challenge. "Since 2005, we've grown in encounters by some 465 percent. We've grown in size and operation only 13 percent. We have these human barriers. We also have financial barriers, the technology we need, and the funding for that technology. These are capital purchases, and we're growing hand-over-fist with this. To do enterprise-wide incorporation of video conferencing is a major million-dollar project. It requires a lot of buy-in and a lot of commitment of capital dollars."

Mr. Gunnell also described the initial infrastructure cost as the main challenge of telemedicine, particularly when convincing local providers to invest. "You go into a

small clinic, they have to spend $6,000 to $10,000 to get an endpoint, and then the annual maintenance is $1,000 or $1,500. Sometimes it's really hard for people to swallow those kinds of investments. To us, we see the value and ... see in the mileage saved and early intervention that it pays for itself, but really it's hard to get people to see that return on investment with some of the investments it takes to get into this."

UVA Center for Telehealth attempts to address the problem by partnering with a variety of vendors. "That's why we really have opened up looking at a lot of different technologies now, just trying to give options to people," Mr. Gunnell explained.

However, pursuing lower-cost technological options can present another set of difficulties. As an example, Mr. Gunnell discussed a seemingly interesting technological device that has so far been eliminated as an option due to overly complicated controls and limited data security. "One of the things they've managed to do is [create] an all-in-one computer monitor, smartboard, and endpoint at a price that's right around $6,000. For all the functionality it gives you, it's a great price, but with a piece of technology that does all that, it becomes very complex. It's not easy to use that type of equipment."

"It's not really about the equipment for us. It's about finding the champions that are willing to go through this with you. If you have people that are not fully vested, the first time you have a technical problem, they derail and run away from the technology."

Brian Gunnell,
Video Conference Network Engineer and Analyst,
UVA Center for Telehealth

Attempting to accommodate existing clinical resources creates another challenge, particularly in establishing sufficient bandwidth in remote locations. Mr. Gunnell stated, "A lot of places are ISDN lines, so basically it's asynchronous, it's not the same upload and download. It's pretty common for people to be able to get a 10-megabits-per-second download speed, but then only have 1.5 megabits up or something like that. Obviously, if you're doing very many clinical encounters and people are utilizing your system, 768 kilobytes doesn't go a very long way."

Educating end users introduces other problems, and Mr. Gunnell gives the example of a rural clinic where UVA Health might offer a significant number of specialties. "We urge a 5-megabit up and down pipe, in and out, so that we have the very best capability to have the very best images we can have. For a single clinic, a 5-megabit pipe would be plenty of bandwidth. The challenge becomes, a lot of these places will try to use that 5-megabit pipe for everything. If they have a couple on their desktops set up and they're watching YouTube videos and we're trying to do a clinical encounter, it can impact."

Aside from solving technological challenges, Mr. Gunnell emphasized the critical importance of locating strong advocates and leaders in the creation of any telemedicine program. "It's not really about the equipment for us," he said. "It's about finding the champions that are willing to go through this with you. If you have people that are not fully vested, the first time you have a technical problem, they derail and run away from the technology. So find partners that are very flexible and will work with you through the bumpy road of getting things started. It's really finding those internal champions that are going to help you grow it, and that are going to use it."

UVA Center for Telehealth plans to continue developing data analytics to identify ways to refine and streamline care delivery. "We've got to be able to make sure that those are quality-managed, and we need to know the data, and we have to

have capability for super analytics on top of this," stated Mr. Gordon. Mr. Gunnell added, "We collect data on a ton of stuff – from mileage, to number of encounters, to number of particular kinds of encounters, to time to encounters, and we keep a performance notebook."

Mr. Gordon emphasized that every telemedicine program will be as unique as the individuals in the organization. "I would urge a place just to try it. You become convinced very quickly that this is technology and service meeting [with] the highest qualities of human existence. I think it is something that every place ... needs to try," he stated. "Everything is a pilot continually in this. As long as you're willing to pilot it to experiment and learn, you become hooked that this is a real resource that can make a real difference to people and communities in need."

## More Information

For more information, please visit http://bit.ly/SYW2ca

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# IoE-based Application Helps *Water For People* Boost Accuracy and Efficiency, Cut Costs



**EXECUTIVE SUMMARY**

### Objective

- Provide clean water and basic sanitation services to people in disadvantaged communities around the world in a uniquely sustainable, scalable, replicable, and non-competitive way

### Strategy

- Leverage smartphone technology to integrate and automate the collection, analysis, and reporting of data pertaining to the condition of water and sanitation projects

### Solutions

- Akvo FLOW is an open-source Android smartphone application used by 116 community support organizations globally for collecting and transmitting survey data

### Impact

- Faster, more accurate data collection
- Reduced costs and effort
- Improved ability to compare data across years and projects

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases — how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions — federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) — to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Water For People

Water For People is a next-generation nonprofit working in water and sanitation programs in many of the world's most disadvantaged communities. It was founded in 1991 in Denver, Colorado, by Ken Miller and John Mannion, former American Water Works Association executives; and Wayne Weiss of Black & Veatch, a global engineering and construction firm. It is dedicated to providing clean water and basic sanitation services to people in disadvantaged communities around the world in a uniquely sustainable, scalable, replicable, and non-competitive way. The organization has been involved in more than 40 countries, and currently oversees water and sanitation service improvements in 10 countries.

FLOW is open source, operates on Android smartphones, and is currently used by 116 community support organizations around the world, including the governments of Liberia and Sierra Leone, and in parts of India.

As part of its international development efforts, Water For People has a 10-year monitoring and collaboration program with each of its assisted districts, encompassing thousands of communities. In order to strengthen and empower these efforts, Water For People utilizes a system called Akvo FLOW that has the potential to transform water and sanitation development work worldwide by offering an integrated way to collect, analyze, and report monitoring data regarding the condition of water and sanitation projects.

FLOW is open source, operates on Android smartphones, and is currently used by 116 community support organizations around the world, including the governments of Liberia and Sierra Leone, and in parts of India. It has been has been adapted to a variety of monitoring systems, including sanitation, health, and agriculture and fisheries, and is providing a new model for data gathering and analysis in the global community.

Ned Breslin joined Water For People as director of international programs in January 2006, and was appointed CEO in 2009. Mr. Breslin focuses on results-driven sustainability and accountability in each of Water For People's development initiatives. He was the recipient of the 2011 Skoll Award for Social Entrepreneurship for his work with Water For People.

Prior to his association with Water For People, Mr. Breslin spent close to 20 years working on water and sanitation projects in Africa. He holds a master's degree in political science from the University of the Witwatersrand in South Africa, and a bachelor's degree in government and African studies from St. Lawrence University.

## Objectives

While many service organizations work to upgrade community drinking water and sanitation systems, Mr. Breslin believes the factors that distinguish Water For People are its long-term involvement in each area of service and its commitment to improving processes based on feedback. "We're constantly looking back, reflecting, building on strength, identifying weaknesses or challenges, and adjusting our programs to address those challenges," Mr. Breslin said.

It was this focus on monitoring and feedback that prompted Water For People to develop FLOW. Because Water For People implements a 10-year plan for each area it serves, regular monitoring is key. "We go back to the areas that we have worked in, and do a basic questionnaire exploring questions like, 'Is water flowing? Are people using toilets? Are the toilets hygienic? Is there money in the account for repairs? How long does it take for repairs to happen if a problem emerges?'"

FLOW is a program for Android smartphones, which FLOW staffers ("Monitors") use to enter survey data. Surveys are customized by area, and the program also takes advantage of the smartphone's GPS mapping and camera functions to include assocated coordinates and visual data.

## Strategy

Mr. Breslin described the previously cumbersome monitoring of projects, saying the process included obtaining GPS coordinates, photographs and video, detailed questionnaires, and much paperwork. Data was then compiled manually and uploaded for analysis, a process that might require months to complete. Mr. Breslin said that the advent of smartphone technology, even in poorest countries, has revolutionized the process, making development of a comprehensive and user-friendly monitoring program possible.

FLOW was developed as a platform on which to conduct these surveys. "We sat back and said, 'Wait a minute: actually, a phone does all of this. I can geo-locate anything on my phone. I take pictures all the time with my phone. Doing a questionnaire with my phone is not unheard of. Surely we can do this,'" Mr. Breslin explained. Water For People teamed with a developer and developed the first edition of the FLOW program.

"In all of our programs, we actually work very closely with district governments," Mr. Breslin said. "We work with their ministry, their district department, [whomever] is responsible for water. We work with the mayor's office. Frankly, they're also the main enumerators. They go out and do the analysis. They go out and do the data collection, then we do the analysis together in something we call Re-Imagining Reporting, where we sit down and look at results."

According to Mr. Breslin, Water For People receives roughly 35 percent of its annual budget from foundations, 30 percent from corporate sponsorships, and about 15 percent from the water and wastewater community, utilities, workplace giving programs, and other similar programs. Additional funding comes from individual donations and other sources.

## Solution

FLOW is a program for Android smartphones, which FLOW staffers ("Monitors") use to enter survey data. Surveys are customized by area, and the program also takes advantage of the smartphone's GPS mapping and camera functions to include associated coordinates and visual data. Once a survey is complete, the data is transmitted back to Water For People servers for analysis and recording. Analysis of the data is conducted jointly with local officials, vesting them in the successful outcomes of their communities.

FLOW Monitors, who work locally for Water For People on monitoring water and sanitation conditions, are provided Android smartphones preloaded with the

relevant FLOW surveys. Although not a downloadable "app" per se, the program looks and functions similar to one. Ease of use was one criterion that Water For People used in the development of FLOW to allow deployment in many different locations and cultures around the world.

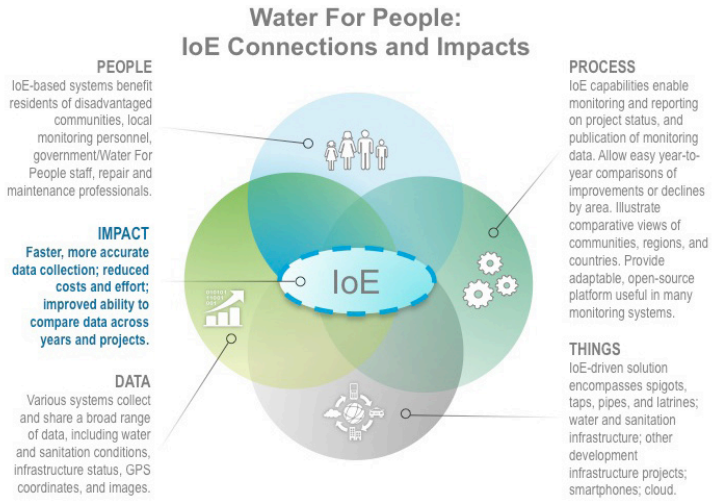
The program collects images and user-entered data on basic water and sanitation infrastructure, such as status of household taps and connections; level of usage; and maintenance conditions. Because many survey areas are remote and without cellular coverage, the program is designed to store the surveys with corresponding photos and GPS coordinates. Surveys are automatically transmitted to a cloud-based database when a cellular service area is reached.

FLOW is now an accepted monitoring standard and model for data gathering in many world communities, including health, education, construction, and agriculture.

Mr. Breslin said that uploaded information can be analyzed in real time, and results are displayed on Water For People's website under the Re-Imagine Reporting section. Significant research went into the design of the reporting program, with efforts focused on creating easy-to-understand, graphic-oriented displays. "We spent a year talking to staff and partners around the world," recalled Mr. Breslin. "We basically said, 'How do you learn, and how do you try to understand things?' Not surprisingly, nobody said by reading a 60-page donor report. It's all visual and color-coded." Now a year into the reporting function's introduction, Mr. Breslin is again conducting field research, and Re-Imagine Reporting 2.0, based on a new round of feedback, is soon to be released.

Water For People chose to make the FLOW program open source. This was done by teaming up with Akvo, a nonprofit organization in the Netherlands that runs a number of data services for international development organizations. Together, Water For People and Akvo have achieved great uptake: FLOW is now an accepted monitoring standard and model for data gathering in many world communities, including health, education, construction, and agriculture.

**Figure 1.** Water for People: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

Water For People is the AWWA designated charity of choice, and is also endorsed by the Water Environment Federation, the Water Quality Association, the National Association of Water Companies, the National Association of Clean Water Agencies, and the Association of Metropolitan Water Agencies. It collaborates with worldwide water and sanitation organizations, and partners with UNICEF and the Millennium Water Alliance, among many others. Water For People is highly regarded in the worldwide water and sanitation communities as a model to follow for sustainable initiatives.

Mr. Breslin said that development of the FLOW program had a dramatic impact on the way his organization conducted both monitoring and reporting. “FLOW did a couple of things for us,” he explained. “One, it reduced errors dramatically. All the errors from transferring from paper to Excel and to SPSS, we reduced that massively. The second thing is, we increased the speed at which we were getting results from months to days, and we were able to publish it quite easily.”

Mr. Breslin sees Water For People as the kind of organization that has the “courage to hear bad news” and adapt to it responsively and effectively, an approach he considers essential.

The impact on the effort and costs involved in data gathering has been dramatic as well. “The burden on our organization has decreased immensely. I would say two-thirds reduction in effort and sweat is probably a fair estimate,” he said.

Mr. Breslin values the increased accuracy and data-gathering efficiency primarily because these benefits support new strategies to improve his organization’s processes. “For us, it’s not about collecting data, it’s about using data that is collected to become a better organization and achieve better results,” he said. “There’s data to show that the places in which we work are trending upwards, and anything that’s going down, that’s not meeting expectations, we’re intervening fairly fast. We’ve become a better organization because of this, and I mean better in the sense that our results are getting better.”

Mr. Breslin sees Water For People as the kind of organization that has the “courage to hear bad news” and adapt to it responsively and effectively, an approach he considers essential. “Reporting is the unique opportunity,” he said. “For us, the really important part is the Re-Imagining Reporting session, where we close the door with our staff, our partners, and government officials. We put the data down, and people dig into it, what’s working, what’s not working, and what do we do differently. Here’s the money that’s on the table, how could we use it better?”

Another advantage of FLOW is that it makes it relatively easy to compare data across years and projects. Mr. Breslin recalled the development of FLOW’s reporting capabilities, saying, “The vision was to basically develop into the program specs, so you could go back and see the results last year, and you fill in the results for this year. You can see what’s improving, what’s not improving, and whether the challenges we identified are actually addressed, or if they’ve gotten worse. You can look at a village, you can look at lots of villages within a particular area and compare those. You can compare different areas. One part of Honduras, you could look at what the results are against another part, and ask why. You can start to compare across countries. Why is it working in Honduras and not working in Guatemala? You can look at regional stuff, like all of Latin America, then you can do it globally. It rolls up really nicely,” he said.

"It's become harder and harder for organizations to [use the excuse] that monitoring is difficult," Mr. Breslin added. "I think what FLOW did is actually take away a lot of the excuses of organizations that, frankly, would rather sit back and say, 'Well, [monitoring] is expensive.' We say, 'Actually, it's not expensive. Here you go.'" The program is having a widespread effect beyond just the water sector, and Mr. Breslin expressed that he is pleased with the impact.

The FLOW program is changing what Mr. Breslin sees as a tendency of nonprofit organizations to sidestep monitoring activities for fear of unpleasant results, possibly compromising scarce funding resources. He views unpleasant data as an opportunity for improvement, saying, "You have to build an organization that can hear bad news, and see it as a challenge, and respond to it."

The FLOW program is changing what Mr. Breslin sees as a tendency of nonprofit organizations to sidestep monitoring activities for fear of unpleasant results, possibly compromising scarce funding resources.

## Lessons Learned / Next Steps

In contemplating the main lessons learned thus far, Mr. Breslin said, "[It] has enabled us to take a hard look at what we do, to ask hard impact questions, and to adjust our program based on results, so that we can actually do better. All these tools are tools that enable us to improve, to serve people around the world in a better way, and to hopefully inspire others to do the same. We have created in a very nontraditional approach – a system that feeds into an organization that is built around not fearing bad news, but actually embraces bad news and poor results as opportunities to innovate."

Mr. Breslin is enthusiastic about the use of FLOW within governments, the various adaptations for other monitoring activities, and the potential for substantive change that this suggests. He described training as in a "very early stage," but said, "Governments are realizing that they want this information. It's really training as much on the analysis, the kind of 'So, what do you do now with these results?' FLOW is just a tool to enable us to get to that point, to get to the analysis," he explained.

"The Internet of Everything is creating an environment where people can see data and respond in different ways, can access things in different ways, and can intervene and support changes in the world that make the world a better place. That's the potential of it. Water For People, in a really weird way, is modeling that. The more open we make results, data, and things, the harder the questions they ask, and the better we get. I think that's the power of it."

# Waterfront Toronto Establishes Critical Infrastructure for Capturing a Host of IoE-Driven Benefits



Images Courtesy of Waterfront Toronto

## EXECUTIVE SUMMARY

### Objective

- Revitalize 2,000 acres of underutilized, vacant, and former industrial brownfields along Toronto's Waterfront into complete, sustainable, mixed-use communities
- Use revitalization of Waterfront as engine for economic growth by attracting residents and new businesses

### Strategy

- Create sense of community in the virtual space through collaboration tools
- Create state-of-the-art Innovation Centre to accelerate Waterfront Toronto's vision and economic development objectives
- Engage and share ideas with other communities around the world

### Solutions

- Fiber-optic open-access ultra-broadband network and community-wide Wi-Fi designed to support community development, sustainable infrastructure, and improved quality of life

### Potential Impact

- Facilitate telehealth improvements that reduce hospitalizations cut costs
- Increase public safety and security through video analytics and real-time sentiment analysis
- Decrease area's carbon footprint and encourage conservation through metering and reporting water/energy consumption
- Promote increased sense of community and vibrant interactive engagement
- Bridge the digital divide by extending network benefits to everyone

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Waterfront Toronto

Waterfront Toronto was established in 2001 as a collaborative effort among the federal, provincial, and municipal levels of Canadian government. Its mission is to put Toronto at the forefront of global cities in the 21st century by transforming the Waterfront into beautiful, sustainable new communities, parks, and public spaces, fostering economic growth in knowledge-based, creative industries and, ultimately, redefining how the city, province, and country are perceived by the world.

The project is one of the largest infrastructure undertakings in North America and one of the largest waterfront redevelopment initiatives ever attempted in the world. Waterfront Toronto's 30-plus-year plan includes cleaning up the aging industrial area and attracting residents and new businesses with an integrated fiber-optic network infrastructure. The goal is to transform the harbor into one the world's leading intelligent communities.

"[This is] the largest urban revitalization initiative in North America. We are building new communities that will be home to thousands of people and workers."

Kristina Verner,
Director of Intelligent Communities,
Waterfront Toronto

Kristina Verner is director of intelligent communities for the Waterfront Toronto revitalization project. In 2012, Ms. Verner was honored with the Queen Elizabeth II Diamond Jubilee Medal for her leadership and commitment to the creation of intelligent communities and collaborative ecosystems. Ms. Verner previously served as research & development officer at the University of Windsor Centre for Smart Community Innovation, and she sits on board of directors for the Intelligent Community Forum Foundation. She is also a founding member of the Board of Advisors for Walsh University's ICF Institute for the Study of the Intelligent Community.

Lisa Prime is director of environment and innovation for Waterfront Toronto, which encompasses the corporate sustainability agenda. Ms. Prime is an environmental planner who has contributed to the Waterfront revitalization since the 2008 Olympic Bid, and has worked for both public and private industry. She led the development of Waterfront Toronto's Corporate Social Responsibility and Sustainability Report (CSRSR), 2012. Lisa received honorable mention by the Clean 50 in 2011, and the CSRSR received recognition by the Clean 50 in 2012 as one of the top 15 projects across Canada contributing to clean capitalism. She also leads the Corporations Minimum Green Building Requirements, which received an international Globe Award for sustainability in 2011. Lisa was appointed to the National Canadian Green Building Council Board in 2014.

## Objectives

In 2001, the City of Toronto resolved to revitalize 2,000 acres of industrial property along the city's declining harbor. The Waterfront Toronto organization – a collaboration of federal, provincial, and municipal governments – was tasked with overseeing the project. "[This is] the largest urban revitalization initiative in North America," said Ms. Verner. "We are building new communities that will be home to thousands of people and workers."

Ms. Verner recalls CEO John Campbell as the driving force behind Waterfront Toronto's ambitious vision, and said his attendance at the 2004 Intelligent Community Forum Summit was a decisive moment. Mr. Campbell inspired his

colleagues with the goal of transforming the Waterfront into a world-leading intelligent community – a vision that has been realized with Toronto having been recognized on three occasions as one of the Intelligent Community Forum's "Top7 Intelligent Communities of the Year." "He very much made the innovation and sustainability mandates a core part of what's happening here today," said Ms. Verner, adding, "John is really an exceptional example in terms of being a leader who truly understands the value of these aspects of revitalization."

"One of the key pieces that differentiates this from a lot of other revitalizations has been the focus on sustainability as well as intelligent communities, where we can actually leverage technology to ultimately improve quality of life for residents, and enhance how people live, learn, play, and invest."

Kristina Verner,
Director of Intelligent Communities,
Waterfront Toronto

## Strategy

The Intelligent Community elements of the revitalization are designed to weave technology into the fabric of the Waterfront community. Ms. Verner noted, "One of the key pieces that differentiates this from many other revitalizations is the focus on sustainability as well as intelligent communities, where we can actually leverage technology to ultimately improve quality of life for residents, and enhance how people live, learn, work, play, and invest." Not only will technology be used to help solve challenges like traffic and parking, but it will also make a difference by facilitating community events and providing ubiquitous access to Internet services. All development is bolstered by an advanced technological infrastructure, including an open-access fiber-optic ultra-broadband network and Wi-Fi throughout the area.

According to Ms. Verner and Ms. Prime, Waterfront Toronto has several roles in the development. It works closely with their carrier of choice to facilitate the construction of the network infrastructure, oversees public improvements such as parks, and sets minimum building standards. By thinking ahead and planning for updates in technology, the Waterfront Toronto team hopes to keep this development at the forefront of sustainable living for years to come. "In terms of any level of infrastructure, we're trying to future-proof this area. It's all state-of-the art infrastructure in amazing public spaces, creating a great quality of place," Ms. Verner noted. Ms Verner and Ms. Prime indicated that while Waterfront Toronto oversees general policy for all areas, the network infrastructure, the development of public spaces, and several remaining redevelopment projects are executed via agreement with private developers who are required to connect their buildings to Waterfront Toronto's ultra-broadband network. "We have a requirement that all buildings must connect to our high-speed broadband," Ms. Verner indicated, adding that treating the Internet connection as a required utility allows the Waterfront development to position transformative applications and services on top of it.

To connect the physical and virtual worlds for residents, Waterfront Toronto is working to create a sense of community in the virtual space through collaboration tools. Thus, before people even move in, they can feel connected to their neighborhood. Ms. Verner explained that, in many cases, future residents purchase their units years in advance, so it's important to help them feel aware of, and involved in, the things that are happening prior to their arrival.

To connect people with cutting-edge technologies, Waterfront Toronto is also pursuing the creation of a state-of-the-art Innovation Centre that will serve as a catalyst for the employment strategy for the area. "It is a beacon, if you will, or the Smart City crown jewel in the Waterfront, where people can actually come and see the latest and greatest technologies that play in a variety of different sectors,"

Ms. Verner explained. She believes that the Innovation Centre will be an effective catalyst for the development of the broader innovation district.

Waterfront Toronto also engages with other communities around the world, sharing their ideas and learning from other communities' developments as well. Ms. Verner believes that these outreach efforts create increased understanding of the goals of Waterfront Toronto. "There is this whole concept, this innovation/collaboration ecosystem amongst other intelligent communities, that supports the sharing of best practices. We're learning from each other in serving as a global leader, as well as a local catalyst," Ms. Verner explained.

"We don't have to worry about whether or not there's going to be enough bandwidth moving forward," Ms. Verner smiled. "We're going to be well positioned to remain competitive for a lengthy period of time here."

Kristina Verner,
Director of Intelligent Communities,
Waterfront Toronto

"Waterfront Toronto is funded by all three levels of government: the government of Canada, province of Ontario, and the City of Toronto," Ms. Verner said. "We are the master developer for the area. Then, for the individual parcels of land that we have serviced and remediated, there are a variety of development partners that are involved." Upon Waterfront Toronto's creation, each of the three orders of government committed $500 million CAD in seed capital to the project. .

Costs associated with implementing smart buildings are borne by the developers, who include these costs in their budgeting process.

## Solution

Ms. Verner describes the fiber-optic ultra-broadband network throughout the development as the "fundamental piece" of the area's infrastructure. "We're going to be leveraging it to connect the community as things move forward," she stated. Unlike some municipal situations in North America, the actual transport layer essentially has been taken care of in this project. "We don't have to worry about whether or not there's going to be enough bandwidth moving forward," Ms. Verner smiled. "We're going to be well positioned to remain competitive for a lengthy period of time here."

According to Ms. Verner, Waterfront Toronto selected a local telecommunications company for the fiber-optic ultra-broadband network installation. In addition to installing the highest level of technology currently available, the company contractually agreed that maximum performance standards will be incorporated into the infrastructure as it is developed – not only throughout construction, but for 10 years following completion of the final building in the development, and all at a competitive cost.

Ms. Verner explained the importance of this contractual clause: "In the Waterfront context, our network provider has to actually keep the network within the top seven in the world in terms of both price and performance on a wholesale basis for essentially the next 30 years, since the carrier is required to maintain these service levels for 10 years after the completion of the last building. So, in that period of time, the neighborhood will not fall behind in terms of their connectivity, which is tremendous. You have to have reliable, scalable infrastructure to be able to ensure that what you are deploying today is future-proof and will be relevant a dozen or more years down the road."

In order to exploit the capability of the network and ensure optimum data transfer speeds, Ms. Verner explained that the fiber-optic cabling does not stop at street level: "It's not just fiber to the building or fiber to the riser – it's fiber to the unit, which is an important differentiator." The next layer of infrastructure, which Ms. Verner describes as the "intelligent platform," runs the Intelligent Operation Center. It has the capacity to handle all different types of alerts or events, such as public safety and security, health and wellness applications, and transportation, capturing that data and translating it into useful information for people. For instance, if there's a transportation issue, this system helps officials articulate that to the general public so that the information becomes useful very quickly. "You have the network, and that's terrific, but what happens on top of that network is what can be transformational," Ms. Verner explained. "We wanted to do that so that we would be able to scale with the community and bring in applications that would be meaningful to the population as it the revitalization continues."

"You have the network, and that's terrific, but what happens on top of that network is what can be transformational. We wanted to do that so that we would be able to scale with the community and bring in applications that would be meaningful to the population as the revitalization continues."

Kristina Verner,
Director of Intelligent Communities,
Waterfront Toronto

Ms. Prime explains how Waterfront Toronto mandates high-performance buildings through its minimum green building requirements. These outline key performance expectation that push developers to contribute to market transformation by outreaching status quo development. This encourages developers to incorporate smart solutions into their buildings. "We don't dictate that you have to put in sensors or monitors, but it's all part of the design expectation. We don't require smart building connections, for example, around safety and security or other opportunities. We have created a framework for performance that drives developers through certain key things they have to do. This sets up an expectation that they're probably going to take low-hanging fruit if you put them halfway there." Ms. Prime places a lot of emphasis on energy-performing design and the opportunity of high-speed broadband and collaborative buildings..

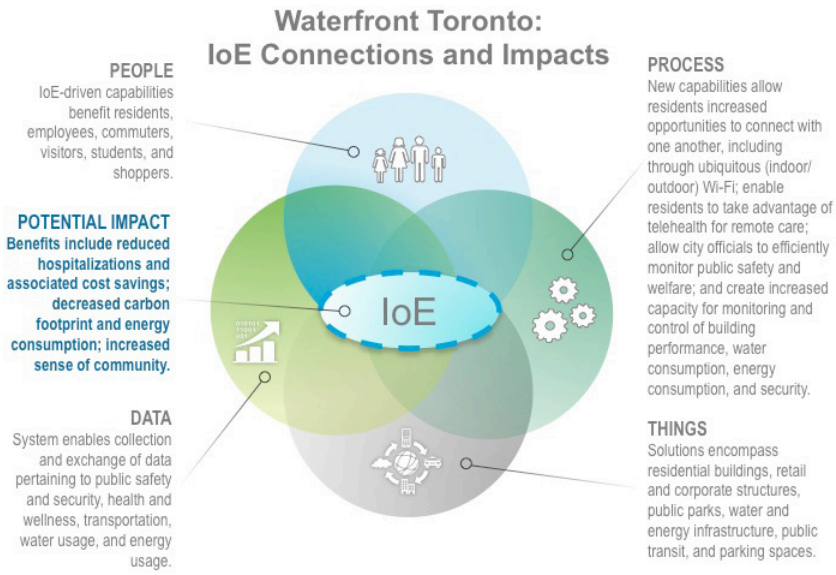
Ms. Prime indicated that in addition to having a network infrastructure that encourages a connected and state-of-the-art community, an example of what the minimum green building requirements contributes is the mandatory installation of metering equipment for monitoring energy and water consumption. "Metering is required because the green building requirements and overall performance in energy and conservation are public-policy objectives and important future proofing opportunities," Ms. Prime explained. Currently, Waterfront Toronto is collecting some energy use data on this network and will do analytics to support objectives of market transformation. It is still too early to decipher meaningful conclusions from the data. Waterfront Toronto is also interested in working with the city to explore the viability of ubiquitous Wi-Fi and other smart and connected infrastructure opportunities.

"The business model has been constructed in a unique way so that there is funding available to make sure that our affordable rental housing in the area has the same access levels as the market housing, so we have a full digital inclusion strategy."

Kristina Verner,
Director of Intelligent Communities,
Waterfront Toronto

Figure 1. Waterfront Toronto: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Potential Impact

Benefits of this project show up in network advancement, community development, sustainable infrastructure, and quality of life. According to Ms. Verner, the purpose of the advanced network infrastructure was to "build a rock-solid platform" that will allow the community to quickly incorporate beneficial applications as they arise. For instance, Ms. Verner anticipates that the network could facilitate telehealth improvements – such as remote physician/patient interactions, physiotherapy, and rehab – that will result in reduced hospitalizations and associated cost savings. The network also makes possible developments in intelligent transportation and delivery of immediate information that contributes to public safety and welfare.

Because the network infrastructure provides an avenue for the flow of "real-time, meaningful, multimodal types of information," Ms. Verner believes it will enhance the sense of community. She described the network infrastructure as "a great platform to help people organize and discover what is happening in the Waterfront area." It will also provide "a digital marketplace to assist the small merchants in the Waterfront, and to provide residents with the enjoyment of buying local and supporting their own neighborhood."

Ms. Verner pointed out that the infrastructure is in place to allow equality of network access regardless of where a citizen is in the neighborhood. "The business model has been constructed in a unique way so that there is funding available to make sure that our affordable rental housing in the area has the same access levels as the market housing, so we have a full digital inclusion strategy. And it's a true open-access network where we can build one highway and everyone can drive across it." This sort of network availability brings tangible benefits to residents, businesses, and visitors alike.

Benefits from the green building requirements include decreasing the area's carbon footprint and encouraging conservation through metering and reporting water and energy consumption. Ms. Prime is vested in finding ways to gather and analyze further data on the actual impact of the policies on current consumption rates and contributions to low-carbon development. "We're very interested in understanding how well we've achieved that, and what further influences may need to happen," she said. The expectation is that policies will augment goals in keeping with Waterfront Toronto's cooperation with the C40 through Climate + (low carbon) objectives.

"Explaining this whole notion of an intelligent community, or a smart, connected community, seems to be a little bit like nailing Jell-O to the wall. Just building the concept of what we're trying to achieve seems a bit abstract to folks that are right on the periphery. Getting buy-in and increasing the number of champions oftentimes is difficult."

Kristina Verner,
Director of Intelligent Communities,
Waterfront Toronto

Ms. Verner stressed that the value of any technological advancement must be measured by its ability to increase quality of life, and she sees part of her role as facilitating an understanding of these advantages in the community. "It's what it's doing for people that's so important," she said, "and unless you can capture some of those informative pieces and make them meaningful to people, then it's not really useful. You just have more servers and more bits traveling through these great fiber connections, but what is it really doing for people? Is it allowing people to stay at home longer? Is it connecting loved ones from afar? They may have benefits that are more difficult to measure in traditional terms such as return on investment, but these impacts are just as important to recognize and place value on."

## Lessons Learned / Next Steps

Ms. Verner described a significant potential challenge of her work with Waterfront Toronto as communicating the benefits of the organization's intelligent community vision in an understandable way. "Explaining this whole notion of an intelligent community, or a smart, connected community, seems to be a little bit like nailing Jell-O to the wall," she said. "Just building the concept of what we're really trying to achieve seems a bit abstract to folks that are right on the periphery. Based on my previous experience, getting buy-in and increasing the number of champions can often times be difficult." Even though practitioners in this field understand the intrinsic value and benefit, she describes the challenge of articulating return on investment without getting too technical or too socially minded.

Because it involves all-new infrastructure, Waterfront Toronto lacks data that would indicate before-and-after results. "It's not like we can say that it's going to save X amount of money over what's currently in place," Ms. Verner said. "Finding the right metrics to articulate value is very difficult. It's not that abstract, but because it seems technical, sometimes it's hard to talk to describe the benefits in a way that potential collaborators really get excited about it." Explaining new ideas can always be something of a challenge, and this project – despite its advanced technology and community benefits – is no exception.

Ms. Prime encounters similar difficulty in garnering the understanding for area developers. "The biggest challenge in putting long term building design demands on developers is the disconnect between operations and the capital perspective on the project," she said. "For example, developers often don't invest in infrastructure that isn't required by law, and oftentimes when requiring infrastructure such as meters, they still push back. Buildings are often viewed as a capital works project that gets handed over – they don't look at operations." She explained that Waterfront Toronto

mitigates the dilemma through an RFP selection process for builders who have a proven record of green building and understand both the requirements and the motivation behind them.

Additional challenges stem from the project's 30-plus-year timeframe. Ms. Prime stressed the need for continual renegotiation during long-term development to allow the community to stay cutting-edge. "One of the problems as you do a development agreement is the building doesn't get built that day. Even if we're in an agreement situation or renegotiating or adding things, I'm always trying to raise performance for what is not built yet because it frankly becomes out of date before it actually goes into the ground." Ms. Prime collaborates with builders to help each structure incorporate the latest technologies available at the time of agreement.

"Always make sure that you're future-proofing. Always have mechanisms built into your model to make sure that your city is able to stay competitive."

Kristina Verner,
Director of Intelligent Communities,
Waterfront Toronto

At a community scale, occasional limitations and missed opportunities can arise due to new technology or lack of operations experience or changed approach for city staff that must take on systems. Ms. Prime explained that some desired policies are prohibited from becoming mandates due to Waterfront Toronto's limited jurisdictional charter. "I personally think it would be great [if] the whole neighborhood could be sensored for all the streetlighting and transportation lighting, and infrastructure flows. But it would all have to be somewhat of a pilot project for the Waterfront because, of course, we're not the entire city, and operations are citywide." Waterfront Toronto works to demonstrate value for the municipality and advance technology via agreement with developers and city decision makers. Sometimes, she reflected, "you can't always have success ,but you can find opportunities to pilot."

Ms. Prime also noted that predicting public response of new residents to a community design can be challenging, specifically concerning use of public transportation. "As a master developer, we are interested in any and all data related to the neighborhood – neighborhood function, how people are behaving, what choices they're making, and so on. The way that the neighborhoods are designed, the expectation was that people would use transit. They would presumably work close to where they live. These are all things that we see in other communities by design, and in some other international cities where they take this approach, but it may not necessarily be what happens once new residents move in."

Learning from the unique challenges of developing an intelligent community, Ms. Verner emphasized that progress requires commitment. "Make sure that you come equipped with plenty of patience," she advised. "There are going to be a lot of stops and starts along the way, but never waiver from good, solid values. Build and maintain trust, and always be transparent, because these intelligent community initiatives are, in their very nature, very much in the full discipline of silo-busting." Every new design requires time and effort to develop, market, and complete.

Ms. Verner considers Waterfront Toronto's forward-thinking plans and infrastructure crucial in a revitalization project. She pointed out that planning for future technological advancements should be a priority for other communities planning similar developments: "Always make sure that you're future-proofing. Always have mechanisms built into your model to make sure that your city is able to stay competitive." By integrating cutting-edge technology and architecture, a project has the best chance of staying relevant as years pass.

Waterfront Toronto is assessing the viability of smart traffic and parking solution pilots. “It’s a great time to plan for these type of solutions since we can build in sensors and other required technologies at the time of initial construction, whereas other cities would need a lot of retrofitting,” Ms. Verner said.

Ms. Prime advised communities seeking to incorporate smart technology to “establish what your core priorities are and what your performance priority should be. Then, locate various technologies that support you in getting to that performance, track the performance, and improve processes and systems.” From Ms. Prime’s perspective, there is room in every community to upgrade key elements such as water and sewer, traffic lighting, energy, and buildings. “When you’re doing new design and you’re doing redevelopment, it’s a great opportunity to pilot things.”

Looking to the future, Ms. Verner concluded, “It’s a matter of really just focusing on best-of-breed solutions, so that the things that we’re launching and the things that we’re introducing to communities can be trusted, that they’re secure, that they’re scalable, because we are going to be growing very quickly.”

## More Information

For more information, visit http://www.waterfrontoronto.ca

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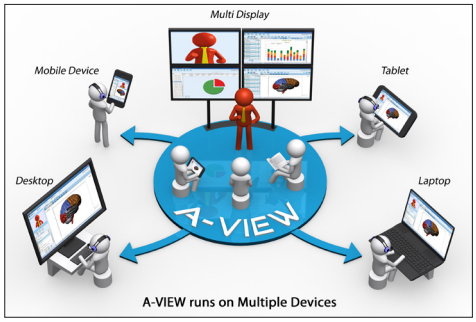
# Internet of Everything and the Public Sector

Jurisdiction Profiles — **Asia Pacific**

CISCO

# Amrita University Taps IoE Capabilities to Extend Educational Reach, Reduce Costs





## EXECUTIVE SUMMARY

### Objective

- Support qualified and expert teachers in training and empowering other teachers throughout India
- Deliver classroom content of the most highly skilled teachers to reach the vast student population across India
- Provide a platform that government officials can use to conduct collaborative meetings, trainings, and seminars

### Strategy

- Leverage the growth of online connectivity to transform distance-learning program into a massive, Internet-based multimedia teaching and training forum

### Solutions

- A-VIEW software allows collaborative, synchronized sharing of many types of multimedia content, including video and audio of lectures, text, associated videos, written instructions, and slideshow presentations
- Content is customized by the teacher, and the delivery pace can be controlled by students

### Impact

- More than 450 universities and 4,000 colleges throughout India and abroad have access to A-VIEW, including 300 participating learning centers, tens of thousands of teachers, and up to 100,000 students
- Allows students to study with high-quality teachers and resources, trains new teachers, and reduces costs for institutions, teachers, and students

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Amrita University A-VIEW

Amrita University was founded in 2003 by humanitarian leader Sri Mata Amritanandamayi Devi. It is a multidisciplinary research university headquartered in Coimbatore, India. Currently enrolling 18,000 students in 150 different degree programs, Amrita has five campuses in India and plans to open an additional six campuses across the country. It is accredited at the highest "A" level by the National Assessment and Accreditation Council, and has Nobel laureate Dr. Leland H. Harwell on its faculty as an adjunct professor. Partnering with several universities in Europe and 20 universities in the United States (including the University of California at Berkeley, Princeton, Purdue, and Harvard), Amrita participates in research, a distinguished lecture series, and other collaborative and exchange programs.

With sponsorship from the government of India, and buoyed by the growth of online connectivity, A-VIEW has transformed into a vast, Internet-based multimedia teaching and training forum.

A-VIEW (Amrita Virtual Interactive E-Learning World) is the distance-learning platform developed by Amrita University. The A-VIEW project was initiated by Sri Mata Amritanadamayi Devi (AMMA) to allow the best teachers to teach the large number of students across multiple campuses. It was implemented to compensate for a shortage of qualified teachers, and originally used satellite broadcasts of classes to extend learning options to Amrita's remote campuses. With sponsorship from the government of India, and buoyed by the growth of online connectivity, A-VIEW has transformed into a vast, Internet-based multimedia teaching and training forum. Now offering collaborative educational activities to more than 450 universities and 4,000 colleges, A-VIEW also provides training for up to 50,000 teachers and 100,000 students worldwide.

Prof. Kamal Bijlani is director of the E-Learning Research Lab at Amrita University. He is a member of its board of directors, and has prior experience as head of the Lab. Prof. Bijlani served as program co-chair for the 2012 International Conference on Technology-Enhanced Education. He is a member of the IEEE (Institute of Electrics and Electronic Engineers) and has published with the organization. His work has been honored with a number of awards, including the Computerworld Honors Program Award for Educational Excellence in the field of Education Technology in 2012.

Vivek Vijayan is technical lead for the Amrita E-Learning Research Lab.

## Objective

According to Prof. Bijlani, India needs to support qualified teachers in reaching the vast population of students. A-VIEW was originally implemented a decade ago as an initiative to bring the classroom content of its most highly skilled teachers to the five campuses of Amrita University.

## Strategy

### From Satellite to Internet

Because of limited Internet connectivity at the time of implementation, the initial version of A-VIEW utilized satellite technology for live video transmissions. Amrita eventually became a teaching hub for the country's EDUSAT distance-learning

program, which used a similar technology to transmit educational content to dozens of additional learning centers.

EDUSAT introduced collaboration with U.S. universities. “EDUSAT was a major international initiative, which was signed between India and the United States,” Prof. Bijlani explained. “We would have some of the best faculty actually come to India, to our campus in Coimbatore, and they would give a talk that would go to all the satellite centers across India – some 40 or 50 centers.”

A-VIEW really began to take off a few years later as high-speed Internet replaced the need for satellite transmission, except in the most remote areas. “The satellite system was good, but it was fairly restricted in the sense that there were just a few teaching nodes in India, Prof. Bijlani said. “Even to be a receiving node for the satellite system, you have to get the satellite installed, you need to have the right connections, and it is restricted to that area or that place. Around 2007, we started looking at A-VIEW on the Internet.” As high-speed Internet reaches more and more students and teachers across India, A-VIEW delivers online classes to more campuses.

A-VIEW really began to take off a few years later as high-speed Internet replaced the need for satellite transmission, except in the most remote areas.

### Government Support

With the support of President Dr. Abdul Kalam and partnering with several major Indian universities, Prof. Bijlani and his colleagues moved the broadcast platform to the Internet. The initiative matured under the administration and financial support of the National Mission of Education, an initiative of the Ministry of Education in India. Of the government’s response to A-VIEW, Prof. Bijlani said, “They appreciated it very much, and ... we started getting full-time funding in 2010.” The government, particularly the Ministry of Education, was motivated to promote A-VIEW as one of the country’s major e-learning venues, and to keep access to the software free of cost to all participating institutions.

The A-VIEW initiative and E-Learning Research Lab were partially developed in cooperation with the National Government of India, under the National Mission on Education through the Information and Communication Technology (NME-ICT) Act. The Amrita A-VIEW program and Research Lab receive funding from the university and from the Indian National Government, with an annual budget of approximately US$1.5 million. Prof. Bijlani described A-VIEW’s initial development as in-house, built by a talented team of software engineers and university leadership.

## Solution

### Project Platform

The A-VIEW software program is a custom product developed by the Amrita E-Learning Research Lab for use on any basic ICT platform. Prof. Bijlani indicated that A-VIEW works on common platforms – such as Windows, Mac OS, iOS, and Android smartphones and tablets – to provide maximum compatibility and mobility. The program is both desktop- and web client-based. Students can download content to their devices, or they can receive it online.

## Collaborative Content Access

According to Prof. Bijlani, A-VIEW allows collaborative, synchronized sharing of many types of multimedia content, including video and audio of lectures, text, associated videos, written instructions, and slideshow presentations. This content is customized by the teacher, and the delivery pace can be controlled by students.

"The content includes your writing, talking, PowerPoint, documents, PDF, animations in 2D, animations in 3D, YouTube videos, and websites," Prof. Bijlani explained. "All of this is part of your content, and you're sharing it. And not just sharing it – you're controlling it live with your students, and they're also able to control it." Instructors can share their notes live with class members using a whiteboard replacement device.

"The content includes your writing, talking, PowerPoint, documents, PDF, animations in 2D, animations in 3D, YouTube videos, and websites. All of this is part of your content, and you're sharing it. And not just sharing it – you're controlling it live with your students, and they're also able to control it."

Kamal Bijlani,
Director,
E-Learning Research Lab,
Amrita University

## Centers

Classroom content is broadcast from designated e-learning centers, and can also be viewed in these centers, as well as from any PC or mobile device with Internet connectivity. Prof. Bijlani indicated that learning centers have a dedicated line with a transfer speed of at least 2 megabits per second. In addition to sufficient Internet connectivity, centers on each participating campus must have a computer, a projector, and a reliable sound system.

## Internet Connectivity

Prof. Bijlani said that A-VIEW software accommodates suboptimal connectivity: "Based on the bandwidth they have available, students can choose to get the teacher's video at high-quality or low-quality stream, thereby reducing dependency on a high-speed Internet connection." While presentations are usually shared via Internet, Amrita's existing satellite infrastructure is used in areas with limited or no Internet connectivity.

## Archiving

Classes are archived for future access and occasional editing. "We record each session, so the user can play it back after the class is over," Prof. Bijlani explained. "The entire session automatically goes into a library. Then, students can watch the class after the session is over, and teachers have the option of editing the actual live video – they can take things out if they want to, and they can insert small segments if they forgot to make an important point." This recording and archiving process enhances the process of course content delivery and retention.

## Evaluation and Feedback

Testing and quizzing is conducted online as well, as are chats and text-based, question-and-answer sessions. Prof. Bijlani described the process: "The students go through [the materials], do some assignments, and do some quizzes by themselves, and they have some gaps in their knowledge. The expert teacher will then come online and the students will register all of their questions into the discussion forum. Then, the teachers answer those questions interactively through a live video conference."

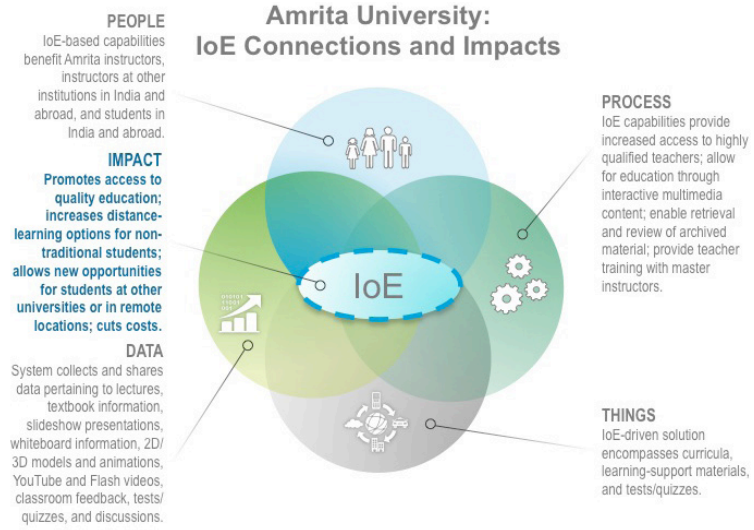
 

Currently, more than 450 universities and 4,000 colleges throughout India and abroad have access to A-VIEW, including 300 participating learning centers, tens of thousands of teachers, and up to 100,000 students.

### Other Training

In addition to classroom activities and large teacher training conferences, Prof. Bijlani indicated that A-VIEW is also used for smaller meetings, workshops, and training.

**Figure 1.** Amrita University: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

The Amrita E-Learning A-VIEW program has been widely popular, and is accessed frequently for learning activities. The work of Prof. Bijlani and his colleagues has been recognized with a number of awards, including the digitalLEARNING award for Best Open and Distance Learning Practices in Higher Education; an award for best distance initiative at the 2011 World Education Summit; and the 2012 Computerworld Honors Award for Educational Excellence in the field of Educational Technology.

### Extended Influence

Prof. Bijlani gave an indication of the vast reach of this program: currently, more than 450 universities and 4,000 colleges throughout India and abroad have access to A-VIEW, including 300 participating learning centers, tens of thousands of teachers, and up to 100,000 students. At a recent 10-day training event dubbed "T10KT," A-VIEW facilitated the training of 10,000 teachers simultaneously in 200 locations. Prof. Bijlani indicated that more than 50,000 teachers have received training in this manner from educators designated as "master teachers." The program brings an additional 50–60 students into each of more than 100 courses among 50 different educational facilities.

### Local Impact

A-VIEW is making a significant impact on higher education in India. Prof. Bijlani emphasized that while the role of local teachers has changed, it has not been diminished. He said, "The static Internet-based lecture may involve reading a book,

watching a video, or seeing a lecture. After the initial lecture, local teachers need to mentor their students, show them examples, show them industry, and lead them through their exercises. That is still the job of the local teacher, fully. We reassure teachers by telling them that their job profile has changed a bit, but that they are still in charge of the local class. Now, rather than just giving a static lecture, they can do more discussions and problem-solving with the kids."

A-VIEW provides many benefits for India's distance-learning education. It allows students to study with high-quality teachers and resources, trains new teachers, and reduces costs for institutions and students.

"The Internet boom in the country has led to a major surge in this public sector. This area has immense scope; however, growth depends on overall development of infrastructure and bandwidth."

Kamal Bijlani,
Director,
E-Learning Research Lab,
Amrita University

### High-Quality Education

Amrita's A-VIEW program has made quality education accessible. Provided free of charge to participating institutions, it has expanded student access to India's best teachers. A-VIEW provides a venue for educational exchanges abroad, and allows up to 100,000 new students in classrooms all over India to participate.

A-VIEW selects teachers for participation based on their qualifications and reputation. In essence, Prof. Bijlani described, this system allows all participating students to attend lectures with the teacher who wrote the textbook on the particular subject – a top-quality learning scenario. Because lectures are recorded and archived, students can review the material to gain a more thorough understanding. Archived videos also allow instructors to adjust content as needed to ensure quality and completeness for subsequent viewers.

### Teacher Training

Beyond connecting students with great teachers, A-VIEW is a valuable venue for enhancing teaching itself. "IIT professors are teaching virtual classes in 100 engineering colleges across India," Prof. Bijlani explained. "More than 4,000 colleges are connected to each other through A-VIEW for online classes, meetings, and workshops. More than 50,000 teachers have been empowered with the teacher training program via A-VIEW." Not only does this program allow more people to be trained at once – it also allows people to access training who would otherwise have been unable to attend. "This process gives an opportunity for teacher training in remote areas; those who cannot travel can attend the training locally without overnight stay," Prof. Bijlani said.

### Reduced Costs

Particularly because it is provided free of charge to institutions, A-VIEW reduces costs for education and infrastructure. It also decreases travel expenses for both students and teachers.

## Lessons Learned / Next Steps

Challenges with expanding A-VIEW primarily involve improving infrastructure and encouraging people to accept this new distance-learning possibility.

## Improving Infrastructure

Prof. Bijlani believes the scale of development for E-learning is limited primarily by the availability and quality of an Internet connection. “The Internet boom in the country has led to a major surge in this public sector,” he said. “This area has immense scope; however, growth depends on overall development of infrastructure and bandwidth.”

Mr. Vijayan concurred, describing how accommodating the lack of existing infrastructure presented challenges in the early days of the program. The team had to invest effort to train users in remote locations regarding the basics of ICT technology. “Basically, we have the technological expertise and people here,” Mr. Vijayan said, “but some of the colleges and the universities in India are in remote places where you need better connectivity, and we had to educate them using these ICT tools because most of them are first-time users of video-conferencing systems.”

“We are realizing that anything built on top of the Internet is going to be extremely powerful. I think that is the very fundamental thing we have learned in the last few years because A-VIEW was so restricted [with] the satellite system. Now, with the Internet, it just opened up a whole new world, even in India.”

Kamal Bijlani,
Director,
E-Learning Research Lab,
Amrita University

To address the learning curve as connectivity began to spread through the country, Mr. Vijayan and his colleagues conducted training both online and onsite, walking coordinators at learning centers through the procurement and use of microphones, cameras, and other equipment. “We had to give them training and recommend products so they could come up to speed,” Mr. Vijayan said. This process is ongoing as more institutions join the A-VIEW program.

## Accepting Technology

While improving infrastructure presented a physical challenge, a less-tangible obstacle Amrita faced related to people’s attitudes toward technology. “You can give somebody a computer, but you can’t force them to use it,” Prof. Bijlani explained. Some teachers were concerned that technology would take away their jobs. “When teachers see that one teacher can teach from one place and the classes are going everywhere, they start wondering, ‘What is my role?’” he said.

Although local teachers may not be teaching at the same level as the A-VIEW teachers are, Amrita works to reassure them that their classes are still fully under their control. Amrita has just, essentially, outsourced the static knowledge (or lecture portion) of the teaching. Prof. Bijlani indicated that A-VIEW is transforming teachers to become mentors who provide support and clarification in the learning process.

## Growth of Distance Learning

Prof. Bijlani is pleased with the progress of A-VIEW as an educational option: “We are realizing that anything built on top of the Internet is going to be extremely powerful. I think that is the very fundamental thing we have learned in the last few years because A-VIEW was so restricted [with] the satellite system. Now, with the Internet, it just opened up a whole new world, even in India.”

While he does not expect a replacement of the traditional classroom, Prof. Bijlani foresees huge growth in online education. “It will become like an online supermarket,” he predicted. “The stigma associated with distance education will

change; it will become huge and available to anyone, anywhere, at an affordable cost. Universities will not only do traditional teaching, but will also do online teaching as well." As distance learning swells in the future, A-VIEW will also expand to facilitate meetings and training sessions.

### Building Partnerships

Prof. Bijlani plans to continue building partnerships with universities and other venues of higher learning both in India and abroad. In addition, A-VIEW is developing an online educational infrastructure for primary, secondary, and senior students to support learning in public schools.

Prof. Bijlani believes strongly in the virtues of online education, and encourages other institutions to come on board with A-VIEW or similar programs. "I think A-VIEW will be extremely beneficial because the whole world will improve as the education of the people improves," he said. "We would encourage everyone to take this up, and we would also be happy to support them and partner with them."

## More Information

For more information, please visit http://aview.in/

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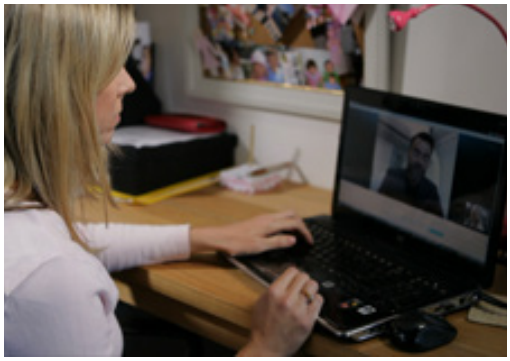
# Australian Government Harnesses IoE Capabilities to Cut Travel Costs, $CO_2$ Emissions, and Energy Usage



## EXECUTIVE SUMMARY

### Objective

- Improve opportunity, efficiency, and quality of life for the citizens of Australia through technology
- More effectively connect Australian states and territories to the Australian government
- Encourage citizenry and businesses to realize the advantages of telework
- Generate efficiencies and productivity by allowing senior government officials to essentially have meetings at their desk, rather than having to travel

### Strategy

- Undertake a staged testing and rollout plan, as well as constant communication with end users about changes and updates

### Solutions

- Immersive telepresence facilities at government offices that encourage virtual meetings and reduced travel
- Policies and programs that encourage telework for both public- and private-sector employees

### Impact

- NTS hosts average of 75 meetings per month across 38 sites, saving taxpayers estimated $1.4 million AUD per month in travel costs
- Reduced burden on road infrastructure, cleaner air, and decreased energy consumption

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases — how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions — federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) — to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Australia National Telepresence and Telework Initiatives

The government of Australia aims to improve opportunity, efficiency, and quality of life for the citizens of Australia through technology. It has pursued multiple initiatives toward this goal, three of which are detailed in this report: nationwide broadband access; immersive telepresence facilities at government offices to encourage virtual meetings and reduced travel; and policies and programs that encourage telework for both public- and private-sector employees.

Abul Rizvi is deputy secretary for digital economy in the Department of Communications of the Australian Government. This role includes promoting use of the National Broadband Network to enable Australians to "take full advantage economic, educational, and social opportunities offered by the digital economy." Duties include activities related to promoting online safety and end-user skills, and establishing a compatible regulatory environment to promote digital transition and capacity.

John Sheridan is chief technology officer and procurement coordinator for the Australian Government, and the current chair of the Standards Australia JTC1 Strategic Advisory Committee. He has worked for the Australian Government in a number of senior IT capacities, primarily for the Information Management Office and the Department of Defense. Mr. Sheridan served as a member of the Standards Australia Technical Committee IT-030 from 2003-2008, and in this role co-authored AS 8015 Standard on the Corporate Governance of IT.

With the arrival of nationwide high-speed Internet connectivity through the National Broadband Network Company starting in 2009, the government wanted to encourage citizenry and businesses to realize the advantages of telework – the effiiciency and productivity achievable at home – enabled by high-speed connectivity.

## Objectives

### National Telepresence System

The Australian government initiated the National Telepresence System (NTS) to support the agenda of the Council of Australian Governments (COAG) and to better connect the Australian states and territories with the Australian government. Mr. Sheridan explained that the NTS is designed to "generate efficiencies and productivity by allowing senior government officials, both elected and nonelected, to essentially have meetings at their desk, rather than having to travel. [It] aligns with the Government's Policy for e-Government and the Digital Economy by making more effective use of ICT to reduce costs, lift productivity, and develop better services."

### National Telework Initiative

With the arrival of nationwide high-speed Internet connectivity through the National Broadband Network Company starting in 2009, the government wanted to encourage citizenry and businesses to realize the advantages of telework – the efficiency and productivity achievable at home – enabled by high-speed connectivity. According to Mr. Rizvi, "large portions of the population around cities are spending between two to three hours a day just stuck in transport." Consequently, transportation departments in some of Australia's major cities have supported the Telework Initiative to help ease the burden on their transport infrastructure.

"There is good evidence, certainly in the private sector, that intelligent use of telework can improve productivity of the workforce," Mr. Rizvi said. "There is also good evidence that it can reduce costs directly to the businesses that are implementing telework. There's also good evidence that businesses that implement telework are able to attract and retain higher-skilled staff more readily than other firms. So there are three important drivers."

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Abul Rizvi,
Deputy Secretary for Digital Economy,
Department of Communications,
Australian Government

## Strategy

### National Telepresence System

In 2009, the Australian government implemented its National Telepresence System (NTS). It installed immersive, room-based telepresence video to facilitate intra-governmental meetings across great distances and multiple jurisdictions. By replacing travel with telepresence meetings whenever possible, the government sought to reduce costs, increase productivity, and decrease carbon emissions. The technological partners for the telepresence units and connectivity were selected for their capacity to produce a highly secure, high-definition, and high-quality audiovisual display of video-conferencing participants over the sometimes vast distances of Australia.

Within the government, the response has been strongly positive. Bookings of the telepresence-equipped rooms have been steady, indicating broad acceptance, and the expansion of the system suggests its popularity as well.

The NTS was funded by the Australian government. Mr. Sheridan explained the system of funding the current system and the plans for expansion: "Funding for the initial system and its subsequent iterations has been through a business case approach to government for funding," he said. "This establishes our core functionality; and then, when it is appropriate, we establish agreements for a user-pays scheme (cost-recovered) to extend the reach beyond the original business case."

According to Mr. Sheridan, the management and oversight of the NTS belongs to the Technology and Procurement Division (TPD) of the Australian government. Within the Department of Finance, the TPD has responsibility, under the Administrative Arrangement Orders of the Australian Government, to provide whole-of-government communications services.

Within the TPD, Mr. Sheridan runs an active operations center that monitors technical aspects of the NTS network. The TPD also provides a service desk for end-user liaison and support.

### National Telework Initiative

The National Telework Initiative seeks to recruit new industries into the practice, increase business efficiency, and improve quality of life by minimizing commute times and maximizing productivity and participation in the workforce. With direction from the Department of Communications, the National Telework Initiative conducts telework promotional activities, efficacy studies, policy development, and telework education efforts.

 

Mr. Rizvi indicated the initiative comes in an environment of enthusiasm for teleworking among employers in the private sector, saying "it's becoming almost standard now" in many industries. These include contact centers, banks, and insurance companies, which routinely employ a large number of teleworkers. Mr. Rizvi also noted that the public sector has been slower to adopt telework, but that the Australian government is trialing telework opportunities across seven agencies to help build a case for further application in the public sector.

Collaboration and outreach are conducted across sectors, including some of Australia's largest industry sectors. "Whenever you provide telework in theory, it doesn't really have much impact," Mr. Rizvi explained. "If you can show a business successfully using telework, that makes a big difference. If the business is in the same industry sector — indeed, is one of your competitors — that is the most powerful thing you can do."

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Department of Communications,
Australian Government

The National Telework Initiative is funded and supported the Australian government. Funds are used in promotional activities, as well as in funding research. According to Mr. Rizvi, some funds have been provided to specific industry groups to help them develop case studies for telework in their specific industries. The government also partners with private entities, such as IT and telecommunications companies, universities investigating work/life balance issues, and transportation infrastructure entities interested in reducing the traffic burden.

## Solution

### National Telepresence System

Thirty-eight sites in government offices throughout Australia were initially chosen for teleresence installation. The service connects the seven Commonwealth Government offices, Prime Ministerial and Cabinet offices, Parliament House, and the offices of Premiers and Chief Minister agencies in every state and territory over a single video-conferencing system. An online booking tool provides the ability to see availability or services and make bookings as required.

Ease of use has been important in users accepting the NTS. Mr. Sheridan indicates that users are sufficiently familiar with the system after a single exposure. "One comes in, looks at the booked meeting, presses the meeting on the screen, and connects," he said. A specialist is also designated to assist users. "Each room has a champion or concierge on-site to manage access," he said.

Mr. Sheridan describes the underlying network of the telepresence system as a hub and spoke design, with centralized scheduling and call switching with distributed endpoints. "[These are] connected through redundant encrypted communications links," he stated, "and core elements are distributed to multiple locations so that single points of failure are eliminated and communications links have, wherever feasible, multiple redundant ways of connecting back into the core."

Mr. Sheridan indicated that the system uses "standards-based, off-the-shelf hardware and software" to allow access to vendor support and maintenance wherever possible. This step lessens the administrative burden of government tech-

support personnel and provides the added benefit of warranty protection. Internal support personnel use a combination of proprietary and open-source tools to manage the video links for both quality and capacity. The approach allows support to anticipate problems "hopefully before they impede our ability to deliver the service," he said.

## National Telework Initiative

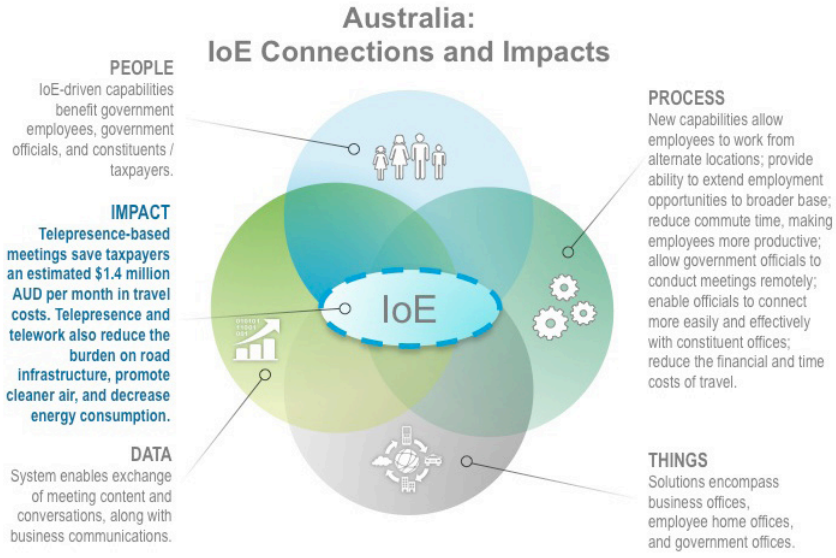
The telework initiative includes a number of components, including education, policy development, promotion campaigns, and technical resources to help managers and employees build a business case for a telework program and establish successful telework principles and protocols. According to Mr. Rizvi, these protocols are critical to program success. "You need to have people who sign up with the protocols and actually adhere to them. When people lapse from them, that's when the problems occur with telework, and the isolation issues, disconnect issues, and disengagement issues arise."

"You need to have people who sign up with the protocols and actually adhere to them. When people lapse from them, that's when the problems occur with telework, and the isolation issues, disconnect issues, and disengagement issues arise."

Abul Rizvi,
Deputy Secretary for Digital Economy,
Department of Communications,
Australian Government

Mr. Rizvi said that with regard to telework application in the Australian government, his office helps to establish a basic structure for optimizing the telework environment, but will leave most of the strategy to the employer. "We set some protocols at the agency level – high-level protocols – and then we've said to the manager, 'You must then modify these to suit your team,' because different people will deal with these things differently."

**Figure 1.** Australia: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

### National Telepresence System

Mr. Sheridan describes the general benefits of the NTS as providing "effective, efficient, productive government work." Reducing travel time is an advantage, particularly in a country as large as Australia, and the savings have been significant. NTS hosts an average of 75 meetings per month across the 38 sites, saving taxpayers an estimated $1.4 million AUD per month in travel costs. Total savings, from initiation in October 2009 up to December 2013, are estimated at more than $72.7 million AUD.

In addition to replacing many conventional meetings, NTS allows officials to communicate more often than they would have before. "People still travel," stated Mr. Sheridan, "but we also probably have meetings where sometimes we wouldn't have had such meetings. Now, there's the opportunity to do that productively and efficiently. We would say increased collaboration is a consequence of this."

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Reduced burden on road infrastructure, cleaner air, and decreased energy consumption are other benefits. Mr. Sheridan said of the NTS initiative, "That's 14,100 tons of carbon dioxide emissions not attributed to the Australian government."

### National Telework Initiative

Because telework is already broadly accepted and applied in the private workforce, the impact is clear: "The bulk of the people participating – both the people in the office as well as the people at home – felt they were indeed part of the team and had not lost contact," said Mr. Rizvi. "[They] had not become isolated from the team because they were teleworking. I think that's absolutely crucial to long-term success."

The Australian government is currently assessing the benefits of telework through the trial being conducted in government agencies. Mr. Rizvi is optimistic about the potential benefits, given the success of telework in the private sector. "We have initiated a trial of telework using high-speed broadband across seven different agencies," he said. He hopes that as a result of the trial, it will be clear that benefits accrue not just to the employee, but to the agency as well. "I think [that's what's] happening in the private sector," said Mr. Rizvi. However, "in order to bring the skeptics with us, we need the evidence."

## Lessons Learned / Next Steps

### National Telepresence System

As with all government data, security within the system remains a top priority. Mr. Sheridan mentioned the difficulty of implementing a broad expansion of NTS within a multi-classification-level system, but believes that "technical solutions are emerging." He concludes: "We hope to work with others within the government and our partnerships to bridge this gap and significantly extend the reach into the broader community."

 

Mr. Sheridan learned that a staged testing and rollout plan, as well as communication with end users about changes and updates, is essential in a successful system deployment. “Technical features are not always forward-compatible,” he said. “As vendors introduce new features into their software, it is sometimes the case that these override or ‘break’ other features that you already have in use. You are torn between providing a new feature and maintaining continuity and familiarity of service.”

To deal with opposition to changes among some end users, Mr. Sheridan has learned to incorporate a touch of salesmanship in introducing new programs or features. “The appetite for technology solutions is not consistent across all users. You need to cater for those who are resistant to change, making sure the benefits of the tools you are providing can be seen in the way they conduct their business, and demonstrating the value of the solutions you provide in a targeted manner,” he stated.

“The key is seamless technology that enables teleworkers to, in essence, feel as if they’re in the office.”

Abul Rizvi,
Deputy Secretary for Digital Economy,
Department of Communications,
Australian Government

Future plans are to expand the system with the installation of 150 EX90 monitors and a telepresence-compatible phone system. Mr. Sheridan said, “In the next iteration of the environment we are hoping to establish a more spontaneous use of the system by providing personal video conferencing units that will allow senior members of the government to interact one-on-one, and with the existing immersive rooms in a scheduled meeting context. We will need to encourage its use in this manner,” he said.

Beyond this Phase II of the NTS system, Mr. Sheridan also stated the government is looking to extend communication to include government-to-business and government-to-citizen connections. Mr. Sheridan believes that with the expansion of the system, it is likely that users will develop custom uses for the technology. He hopes to “allow for more organic use cases to emerge as familiarity with the system widens.”

## National Telework Initiative

For telework to succeed, employees at home and in the office need to feel that the experience is the same, if not better, than when everyone worked together in an office. Teleworking employees need to have access to all of the applications that they need to do their work. Employees also need to have access to their colleagues in the same way they would if they were in the office. “The key,” said Mr. Rizvi, “is seamless technology that enables teleworkers to, in essence, feel as if they’re in the office” – technology through which the teleworker can almost always be seen by the rest of the team and the teleworker can see the team. He believes that video technology, for one, is important in achieving that: “We think that’s essential. Just as the telephone is a natural part of the way you work, video conferencing has got to become a natural part of the way you work.”

 

Mr. Rizvi has also found that governments must establish a basic framework that addresses many of the issues of teleworking in order to promote a consistent and successful experience. “In terms of lessons learned, apart from getting the technology right, the other dimension of this is that you really do need to spend some time with both managers and the teleworkers and their colleagues developing some protocols for how they will work together, and if you don’t get the protocols right, then problems arise and they fester.” In addition, the protocols need to be revisited frequently, such as biannually.

## More Information

For more information about the National Telework Initiative and National Telepresence System, please visit http://www.telework.gov.au and http://bit.ly/1iPwuau

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# Busan Leverages IoE Connections to Improve Public Safety and Security



**EXECUTIVE SUMMARY**

### Objective

- Enable centralized management of risks due to natural disasters and urban crime
- Monitor tunnel and road hazards, and alert the public of traffic conditions

### Strategy

- Use the city's high-speed broadband network as a platform for eight distinct public safety initiatives

### Solution

- Integrated fiber-optic network with 10-Gbps broadband capability
- Wired and wireless sensor and video networks monitor the public infrastructure for air quality, road conditions, fissures, fires, flooding, and other hazards
- High-definition video monitoring for crime prevention in risk-prone areas
- Remote medical care for patients in ambulances

### Impact

- More efficient traffic management; reduced loss of life and property from natural disasters; improvements in air quality and patient care
- Comprehensive citizen alert system enables the public to better prepare for and cope with natural disasters, traffic, and fires in tunnels, underground markets, and other public places

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Busan's U-City Safety & Security Initiative

Busan Metropolitan City is South Korea's second-largest city and home to the fifth-largest port in the world. The Busan government has invested in a widespread high-speed broadband infrastructure — and in a broad combination of "U-City" initiatives based on the idea of *ubiquity* supported by *information technology* ("U-IT") to enable the exchange of information anywhere, anytime.

Busan's U-City Safety & Security initiative is a wide-ranging effort to monitor and collect data relating to city safety issues. Officials use the data to make preemptive decisions and to keep citizens informed. U-City Safety & Security encompasses eight main programs focused on natural disaster monitoring and alerting, traffic and transit efficiency, infrastructure, and crime prevention. Each program involves different governmental and ministry partners, although some are solely funded and operated by Busan Metropolitan City.

Kim Gwang Hoi is Busan Metropolitan City's strategy and finance officer. He oversees the Busan U-City Safety & Security initiative.

The 2004 South Asian tsunami and a 2005 earthquate off the coast of Japan spurred Busan's desire to implement technology-based safety and readiness measures.

## Objective

The 2004 South Asian tsunami and a 2005 earthquake off the coast of Japan spurred Busan's desire to implement technology-based safety and readiness measures. The city built a network to enable centralized management of risks from natural disasters and urban crime, and in 2007 established a warning system for earthquakes and tsunamis.

At a basic level, this warning system analyzes forecasts and provides alerts to the public. To facilitate the systematic collection and sharing of data in emergencies, Busan's system utilizes cutting-edge video, high-speed Internet, sensors, and closed-circuit television (CCTV) technology. Through a combination of initiatives, Busan can disseminate information about a situation, enable quick and appropriate response, and minimize loss of property and life.

While natural disasters occur rather infrequently, traffic-related dangers can occur daily. So Busan also created a monitoring and alert system for the city's tunnels. "Busan has many tunnels: if an accident happens in one and traffic begins to back up, it quickly becomes a safety matter," Mr. Kim explained. So we built a platform for integrating the security infrastructure with the warning systems and CCTVs we had already set up to monitor tunnel collapse and creek flooding."

As the city tackled issues surrounding natural disasters and traffic safety, it became apparent that other areas could also benefit from centralized, smart management.

## Strategy

In 2007, Busan laid 1,278 kilometers of fiber-optic cable capable of handling large information flows. Previously, the city had relied on the services of a major local telecommunications company, but the network speed was slow and the service expensive. By using its own network, the city now has the capacity to monitor multiple elements, and to operate application services that push information to users' devices for free.

The Busan U-City Safety & Security programs comprise eight initiatives that utilize technology to collect and disseminate safety data for the citizenry:

- **U-City Safety System Strategy** and U-IT-based smart service systems are disaster management models that work with departments responsible for disaster relief. This initiative includes intermediate and long-term disaster management plans for the overall system. One example is the use of mobile video-conferencing technology in ambulances, which enables doctors to communicate with emergency responders in the vehicle. It was completed in 2007.
- The **Earthquake and Tsunami Forecast and Warning System** issues real-time earthquake-related tsunami warnings. It works in conjunction with the civil defense warning system by connecting 42 warning terminals and seven CCTVs at strategic areas along the coastline. It was built from 2005 to 2007 with funds from both Busan City and the central Korean government.
- The **Integrated Platform for U-Safety Infrastructure** enables central management of disasters across Busan and is a joint project with the Ministry of Land, Infrastructure and Transport. A Central Disaster Management Center has real-time monitoring capabilities of three pump stations, a wireless infrastructure net comprised of 21 CCTVs, and 15 wireless transmission stations. The Busan City Disaster Safety application provides disaster, weather, and traffic-related information to the public. This system was built from 2007-2009, and was jointly funded by the central and city governments.
- The **Ubiquitous Sensor Network (USN)-Based Tunnel Monitoring System** monitors tunnel interiors and ensures prompt responses to hazards. A total of 79 sensors and four electronic displays operate in the Mahn-deok and Gu-deok tunnels. A wireless system allows the city to monitor for hazards, control traffic, and respond quickly to emergency situations. This is a joint project of the Ministry of Information and Communication and the Busan Infrastructure Corporation, built from 2007 to 2009.
- The **U-IT-Based City Facilities Safety Model,** a joint project with the Ministry of Security and Public Administration, uses CCTVs to collect information and monitor traffic along the city expressway. Completed in 2011, it also has a sensor system that detects traffic flow and road conditions. In the Nampo and Gwangbok underground marketplace, CCTVs detect fires and other facility safety issues, and sensors measure indoor air quality.

By using its own network, the city now has the capacity to monitor multiple elements, and operate application services that push information to users' devices for free.

- The **U-Safety Flood Forecast System** uses video monitoring in five locations to collect and analyze rainfall volume and water level data. Information is then disseminated to the public through the Busan City Disaster Safety application, which is available on any Internet-enabled device. "So many people have built their homes along the banks of the Nak-dong and Soo-yeong Rivers, which have become heavily occupied residential areas," explained Mr. Kim. "Our first priority was to manage these two riversides, and we have so far successfully avoided damage when flooding has occurred." Built in 2012, the project was jointly funded by Busan and the Ministry of Land, Infrastructure and Transport.
- The **Security CCTV System** was installed to monitor criminal activity in child protective areas, city parks, and other high-risk locations. Between 2009 and 2014, nearly 3,000 closed-circuit video monitoring cameras were installed.
- The **Integrated CCTV Control Center** was developed to analyze data collected from video monitoring cameras from different areas and agencies. The data center facilitates prompt response to emergencies, and permits communal use of video resources among agencies.

Busan utilizes a complex integrated network and CCTV monitoring system to facilitate its safety and warning systems. These technologies collect data, analyze it for official purposes, and then transmit relevant information to citizens via the Internet.

As U-IT projects require both substantial up-front investment and research and development, a large portion of the project was funded and sustained by the federal government. Of the 64.7 billion Korean won (US$62.8 million) spent on the combined projects, 27.6 billion won (US$26.7 million) was contributed by the federal government. "The central government was on the same page as our city government about the importance of an integrated approach," Mr. Kim said. "So, financially, the central government budget and city budget were combined to build the system." An annual system maintenance budget equivalent to a certain percentage of the total purchase amount is allotted by the city government.

## Solution

Busan utilizes a complex integrated network and CCTV monitoring system to facilitate its safety and warning systems. These technologies collect data, analyze it for official purposes, and then transmit relevant information to citizens via the Internet.

Busan Metropolitan City planned and implemented the project. Although each city agency is responsible for operating its specific part of the program, Busan maintains operational control of program outcomes. Such centralized ownership helps stabilize operations and facilitates remediation if malfunctions occur. Having a unifying umbrella also enables collaboration and data sharing among the different initiatives. An IT firm provides services, maintenance, and advisory support when necessary.

### Integrated Network

The network infrastructure consists of 1,278 km of optical-fiber cable, 334 individual pieces of equipment, an integrated network management system, and an integrated security control system. It features transmission speeds of 622 Mbps to 10 Gbps, three 10G backbone networks, 23 2.5G access networks, and 71 server-

accessing networks. “Our security system and transit system collect data via wired and wireless networks,” Mr. Kim explained. “We also have a network system for collecting data from sensors and video, and this data is sent to our control centers via the wired network.”

## CCTV, Sensors, and Monitoring

Busan’s U-Safety Flood Forecast System is an onsite monitoring system that manages and collects data from sensors and transmits the data to remote hardware. CCTV records images that are then sent to video servers for data storage and transmission. An IP network facilitates long-distance communication between the operating system and onsite monitoring system. There are five total CCTVs in different locations, and information is relayed to citizens via the Disaster Safety application.

The Ubiquitous Sensor Network Tunnel Monitoring System uses 10 types of sensors to monitor vibrations and structural deformations in the tunnels. It employs a wireless monitoring system to analyze collected data for illumination, air quality, and the presence of smoke and/or fissures in the structure.

Busan’s Integrated Platform for U-Safety Infrastructure provides real-time monitoring of three pump stations, a wireless infrastructure net consisting of 21 CCTVs, and 15 wireless transmission stations. It also manages the Busan City Disaster Safety application, which provides disaster, weather, and traffic-related information to the public.

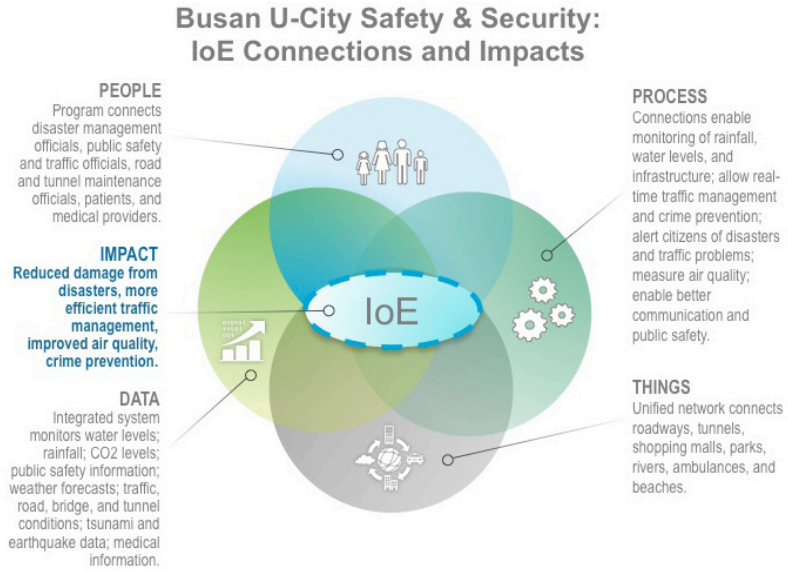
The Ubiquitous Sensor Network Tunnel Monitoring System uses 10 types of sensors to monitor vibrations and structural deformations in the tunnels. It employs a wireless monitoring system to analyze collected data for illumination, air quality, and the presence of smoke and/or fissures in the structure. Four electronic displays relay information to commuters.

The U-IT-Based City Facilities Safety Model has two CCTVs, along with a sensor system to detect traffic flow, speed, roadbed conditions, and fissures. At the Nampo and Gwangbok underground marketplace, CCTVs and automated indoor air quality sensors monitor facilities to ensure safe management. Two electronic displays relay traffic information to the public.

The Security CCTV System was created using the IPv6-based Busan Information Highway, the city’s 10-GB broadband infrastructure. The network includes optic converters and L3 switches to allow rapid high-definition video monitoring for the 2,995 CCTVs currently installed. CCTVs consist of cameras, poles, and control boxes.

Figure 1. Busan: New and Better Connections.




Source: Cisco Consulting Services, 2014

Each of Busan's programs provides unique benefits, such as efficient traffic management, disaster alerts, improved health services, and crime prevention. Together, they enhance many city functions by increasing safety and improving delivery of useful information to residents.

## Impact

Each of Busan's programs provides unique benefits, such as efficient traffic management, disaster alerts, improved health services, and crime prevention. Together, they enhance many city functions by increasing safety and improving delivery of useful information to residents.

### Reduced Damage

By integrating data and forecasting, the Busan Metropolitan U-City plan can both enable preparation for natural disasters and limit the loss of life and property when disasters occur. The system also predicts areas at high risk for flooding by analyzing weather data and precipitation characteristics.

### Efficient Traffic Management

The USN Tunnel Monitoring System allows real-time management of tunnels, enabling traffic management officials to stop inbound traffic and quickly respond to emergency situations. It enables officials to identify traffic congestion situations within one minute, and quickly return traffic conditions to normal. By increasing its efficiency, Busan was able to reduce staff and material costs by 50 percent, and to lower its electrical costs as well.

### Disaster Alerts

In the event of a natural disaster such as flooding or earthquake, citizens can receive information and instructions through the Busan City Disaster Safety app and SMS messaging, along with coastal warning sirens.

## Information Sharing

The Integrated Platform for U-Safety Infrastructure allows Busan to analyze and respond to situations through centralized management, and to share information among relevant organizations.

## Air Quality and Service Improvement

The U-IT-Based City Facilities Safety Model has improved environmental air quality, and expedited response to fire incidents through real-time unified fire monitoring. It also reduced maintenance costs by assisting in the renovation of existing non-functioning hardware.

"Citizens have not yet been exposed to extreme dangers, but if a sudden disaster occurs in the future, they will discover how well the system is working. So far, I think citizens are happy about our service and information delivery."

Kim Gwang Hoi,
Strategy and Finance Officer,
Busan Metropolitan City

## Crime Prevention

The Security CCTV System helps prevent crime in risk-prone areas. It enables rapid response by transferring data collected from high-definition video monitoring through the Busan Information Highway. The Integrated CCTV Control Center unifies operation and management systems, preventing overlap. It also creates jobs for the regional economy with the hiring of staff for the control centers.

## Saving Lives and Improving Health

According to Mr. Kim, Busan's U-Health project (under the U-City Safety System Strategy) has brought the benefits of ubiquitous connectivity to the level of the individual citizen by connecting ambulances with hospitals using telemedicine and sensors for patients' vital statistics. "A patient in an emergency vehicle can be saved by the 'presence' of a remote doctor," he explained. "This program has become very popular among our citizens, and doctors are relieved because they can advise emergency management technicians about what to do, even though they are not present in the emergency vehicle."

According to Mr. Kim, public support for the overall program has not been measured in an official capacity, but the government can measure success based on the applications downloaded and used by citizens, especially with the popular bus and subway schedule apps. "We can measure the citizens' satisfaction with these types of services because they use them every day," he said. "However, disaster service applications have not been used often enough to measure citizen response. Government officials use the system more often because they monitor and announce current information to citizens."

Mr. Kim says that a disaster or flood will be the true test of the system's effectiveness, enabling the city to understand public reception of the disaster applications more clearly. "Citizens have not yet been exposed to extreme dangers, but if a sudden disaster occurs in the future, they will discover how well the system is working," Mr. Kim said. "So far, I think citizens are happy about our service and information delivery."

## Lessons Learned/Next Steps

Busan's biggest challenges with regard to its U-City Safety & Security programs involve maintaining existing sensors and technology, and determining which services are returning the most value for the city and its residents.

### Ongoing Maintenance

Smart systems require continued upkeep to deliver return on investment. Some existing carbon monoxide and smoke sensor systems have suffered breakdowns because of the tunnel environment. The particular needs of such environments require continuous attention and support to ensure efficient operation.

According to Mr. Kim, one of the most important lessons Busan learned was how to keep the U-City systems up to date with evolving technologies and methodologies.

### Determining Services

"Because it is a complex, time-consuming process," Mr. Kim explained, "our biggest challenge today is defining which systems should be developed first and which services should be offered to citizens." Since multiple systems make up the complex U-City project, Busan often struggles under the sheer weight of data to determine which initiatives provide the best return on investment and citizen benefit. "Due to the complexity of the systems, we have not been able to quantify their efficiency," Mr. Kim laments. "We will keep working on verifying future network needs – learning how they will improve citizens' lives, and how we can retrieve more information from established systems."

### Technological Evolution and Governance

According to Mr. Kim, one of the most important lessons Busan learned was how to keep the U-City systems up to date with evolving technologies and methodologies. Many people provided useful input, and Mr. Kim acknowledges, "Our city has been managed more efficiently utilizing new technologies, and we have learned so much in the process. Today we are much more technologically advanced." Each advancement has spurred even further growth. "We have become smarter from the perspective of city management," Mr. Kim elaborated. "Rather than figuring out how to utilize our existing technologies, now we are focused on learning how to create service models in developing technologies."

Busan Metropolitan City officials also learned that laws need to catch up with technology in order for services to be effective. Mr. Kim cited the ability of medical personnel to treat patients remotely – the patient could be at home or in an ambulance – using information from sensors. While the technology has been available for six years, it was only this year that the government amended laws to make remote treatment legal. "A service model can be born from technological evolution and accumulated experiences, but it also needs systematic support from the government, which takes a long time," Mr. Kim said. "Our big-picture plans have not been implemented as fast as we'd hoped, but they will be realized faster in the future."

## Future Plans: Expansion and Information Sharing

With 13 out of 16 city subdivisions and counties already outfitted with Integrated CCTV Control Centers, Busan Metropolitan City plans to complete implementation across the rest by 2017. Busan is also implementing the seventh phase of Security CCTV installation, adding 470 more crime-prevention CCTVs.

To fully realize the potential of the U-City initiative, Busan is releasing all government-owned information to private sector entities for the benefit of citizens. "A well-built service model is critical," Mr. Kim explained. "Several elements factor into building it successfully – supportive government, business entities, engaged users, systematic regulations, adequate funding, and others. Although we are still in an initial stage, we have accumulated several small, successful use cases to build on." Busan plans to improve the service model faster by sharing experiences.

"We are trying to establish a comprehensive infrastructure for comprehensive service offerings. Our mission going forward is to create a system that contains all information in one place: a citizen lifestyle application."

Kim Gwang Hoi,
Strategy and Finance Officer,
Busan Metropolitan City

## Next Steps: Accessibility and Integration

Perhaps the most complex next step will be to fully integrate all of the systems so they provide automatic warnings and alerts, and deliver key information to applications on any device that can be accessed conveniently by anyone. According to Mr. Kim, "This integrated system should provide all information requested, regardless of location, time, day, established network services, or device."

Along with enhancing accessibility, Busan is looking toward one-stop shopping in the context of data. It is designing an integrated application that will inform citizens about dust in the air, weather, and leisure activities, as well as safety and security. "I don't believe citizens are happy with the safety and security system alone," Mr. Kim explained. "We are trying to establish a comprehensive infrastructure for comprehensive service offerings. Our mission going forward is to create a system that contains all information in one place: a citizen lifestyle application."

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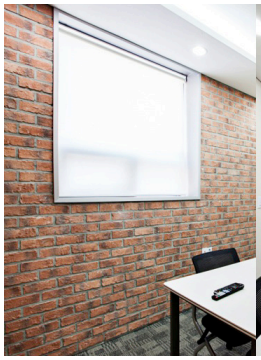
# Korean Government Uses IoE-Enabled Smart Work Centers to Boost Productivity & Job Satisfaction



## EXECUTIVE SUMMARY

### Objective

- Address concerns regarding environmental pollution and global warming, as well as issues such as employee productivity, the aging population, and a desire to encourage parents to have more children

### Strategy

- Extensive planning and research allowed government officials to anticipate potential problems and plan for necessary transitions, particularly when special considerations had to be made
- Government conducted surveys and employee task audits to determine the suitability of allowing employees to utilize the centers

### Solution

- Smart Work Centers allow civil servants to perform routine work tasks closer to where they live, forgoing a long commute to the head office
- Centers also feature facilities designed to reduce long-distance business travel, such as teleconferencing rooms

### Impact

- To date, government has established 13 Smart Work Centers, which are utilized by employees from 36 central government agencies, 28 local government agencies, and 71 public organizations
- Smart Work Centers have increased productivity, saved commuting costs, and boosted overall life and job satisfaction

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Korea's National Information Society Agency

Korea's National Information Society Agency, or NIA, conceived of the Smart Work Center to function as a local, shared, secure office space for Korean government employees across departments and functions. By working from their respective local Smart Work Centers, civil servants can perform routine work tasks closer to where they live, forgoing a long commute to the head office. Centers also feature facilities designed to reduce long-distance business travel, such as teleconferencing rooms. There are currently nine centers for daily commuters and four centers for business travelers, which have been utilized by 137 public-sector entities and 70,000 public-sector workers.

Dr. Byung-Joo (Daniel) Jeong, chief researcher for NIA, coordinates the implementation and operation of Smart Work Centers with the public sector, and is working toward establishing them within the private sector. He helped to establish the Smart Work Center, and has been in his role since 2009. Previously, he worked to establish the National IT Policy Master Plan, and was a working-level director for National Information Society Strategy and Performance Management for South Korea. Dr. Jeong has a doctorate of philosophy in management of information systems from Kookmin University.

The system is aligned with the current government's management philosophy, which includes a smart e-government policy, driven in part due to concerns regarding environmental pollution and global warming, as well as issues such as employee productivity, the aging population, and a desire to encourage parents to have more children.

## Objectives

According to Dr. Jeong, the South Korean government started preparations on the Smart Work Center system in 2009. It was approved in 2010 by then-President Lee Myung-bak. The system is aligned with the current government's management philosophy, which includes a smart e-government policy, driven in part due to concerns regarding environmental pollution and global warming, as well as issues such as employee productivity, the aging population, and a desire to encourage parents to have more children.

Separately, the relocation of several ministries and national agencies from Seoul to Sejong City, which began in earnest in 2012, necessitated the establishment of Smart Work Centers. "[The relocation] caused a great deal of burden from the government's perspective, since commuting time for workers has become much longer," Dr. Jeong said. "And that results in a very ineffective use of time for workers. Additionally, [there are] increasing business-trip expenses and so forth. That is why the government made a decision to carry out the mission of constructing the Smart Work Centers. Even within Seoul, workers spend an hour and half to commute. In order to solve these problems, building Smart Work Centers was inevitable. So they were built in the residential areas where the government officials are clustered."

## Strategy

As part of the process of establishing the centers, the government conducted surveys and employee task audits to determine the suitability of allowing employees to utilize the centers. The survey found that 47.7 percent of government knowledge workers' duties could be accomplished from a Center at least one day each week.

The Ministry of Security and Public Administration (MOSPA) supervises all affairs related to establishing Smart Work Centers, while the National Information Society Agency is charged with constructing and operating the Smart Work Centers. The Korean government owns the facilities and technology. Data is stored on the government cloud service, while data transfer and storage are managed by Chung-an Information Communication Company. The Smart Work Centers are open to central government officials; some local government officials are also approved to use the centers.

Because they are operated solely by the government, the Smart Work Centers have not been promoted publicly. However, the National Information Society Agency is looking to integrate Smart Work Centers into the private sector. "We are targeting private-sector business organizations to encourage implementation of the Smart Work Center system," said Dr. Jeong.

The size of each center varies, so there is not a fixed cost per location. The South Korean government backed and funded the Smart Work Center project. Because the project was written into the general annual funding, specific financial information is not available.

At present, the government has established 13 Smart Work Centers, which are utilized by employees from 36 central government agencies, 28 local government agencies, and 71 public organizations.

## Solution

At present, the government has established 13 Smart Work Centers, which are utilized by employees from 36 central government agencies, 28 local government agencies, and 71 public organizations.

Private-sector IT companies install the video-conference systems, network firewalls, building security systems, and business software programs. Each Center works with a management company to manage daily operations. Each day, a different management team takes care of the Center.

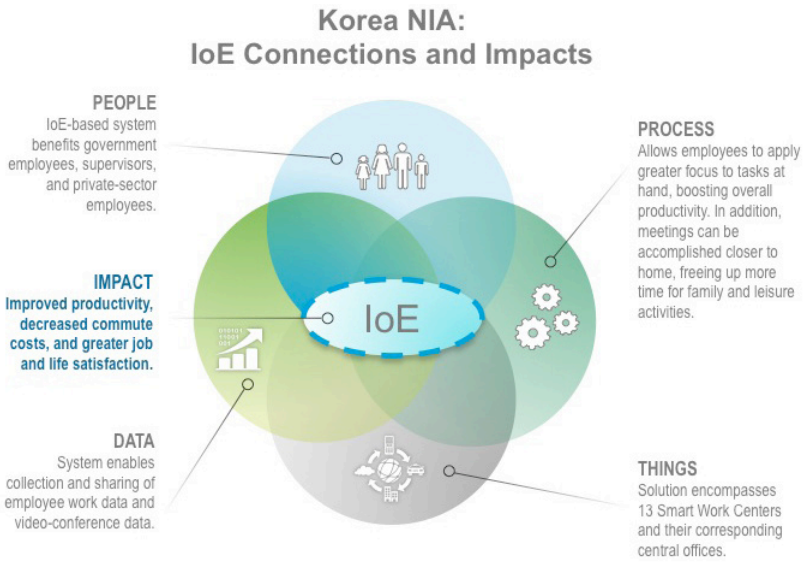
Office fixtures are furnished to mirror the main government offices as closely as possible. The facilities are secured by entrance security systems to ensure only authorized individuals enter Smart Work Centers. A biometric recognition system analyzes blood vessel patterns (handprint) of individuals entering the facilities, and CCTV systems are installed to allow monitoring.

The telephone and video-conference systems enable continuity of work relationships with colleagues and supervisors in the main office. Desktop computers are connected to the government's internal network, and data needed for a day's work is moved to the cloud-based server. Workers can call up data and work in the closed network. All data and information is kept within the office and servers (no South Korean public employee is issued a laptop) because public data security is of highest importance to the government.

Data security is handled by a Korean company, which hosts cloud services, data transfer, and storage. Data is protected by government public key infrastructure secure networks, and workers can access projects and files by server or cloud-based storage.

**Figure 1.** Korea NIA: New and Better Connections.




Source: Cisco Consulting Services, 2014

"Although cost saving is very insignificant due to the increased working space, if a worker's productivity boosts by 20 percent, we consider our mission accomplished."

Dr. Byung-Joo (Daniel) Jeong,
Chief Researcher,
Korea National Information Society Agency

## Impact

Some workers use the centers every day, while others utilize them only on a weekly or monthly basis. According to Dr. Jeong, the increased productivity of workers is invaluable. "Although cost saving is very insignificant due to the increased working space, if a worker's productivity boosts by 20 percent, we consider our mission accomplished."

He also says that the system saves employees money in the form of commuting costs. This has led to more overall life and job satisfaction for workers. "For a worker to finish one project usually takes four hours," said Dr. Jeong. "But working at a Smart Work Center makes a difference, so it only takes two hours because [the worker] can focus solely on the work."

In a survey conducted by the government, researchers found that 92.1 percent of Smart Work Center users reported overall satisfaction with the centers, including commute time savings and added productivity.

According to Dr. Jeong, South Korea's success with Smart Work Centers has put a positive international spotlight on the project and caused other agencies and organizations to ask for reports and assistance. "OECD and UN Public Administration are some of those," he says. "We have summarized related materials to distribute to those organizations, and we are supporting the endeavor of the UN Public Administration."

## Lessons Learned / Next Steps

Extensive planning and research allowed government officials to anticipate potential problems and plan for necessary transitions, particularly when special considerations had to be made. Dr. Jeong learned that it was easy to reroute the directions of a project if analysis showed there was a better way. “Analysis and understanding the need of the entity should precede doing any ground work – analysis on whether the project fits the organization, planning how to manage Smart Work Centers, and how to make the users happy. [Simply] following others’ footsteps without serious analysis would not be right. Without the preparatory work [we did], the project would not be successful.”

Dr. Jeong says that one of the most challenging obstacles was convincing Smart Work Center workers to buy into the system, and developing institutional changes to reinforce the benefits of the program to workers and managers. This stems from a perception among workers that because they are no longer in the primary physical office, directly supervised by their manager in real time, their performance evaluations will be negatively affected. “It has been three or four years since we started this project, but they still worry about this,” he said.

The NIA’s goal is to expand its own Smart Work Center Program to help the public sector become more efficient, and to encourage and help organizations nationwide to apply IT technologies to increase global competitiveness.

To quell concerns, the government published a guidance manual listing the business tasks that can be completed at Smart Work Centers. Laws were also passed to protect workers’ rights and reinforce to managers that effective work could be completed at the centers. “The content of the law says that, excluding facility-management duties and security-related duties, almost all business is allowed to be completed at Smart Work Centers,” Dr. Jeong said. “Task analysis is in progress, which includes naming the tasks that can be utilized at Smart Work Centers and the frequency a worker can work at Smart Work Centers according to his or her types of duties.

“We implemented mandatory orientation hours,” Dr. Jeong continued. “In job training and promotion training, we have implemented Smart Work Center-related culture change training, sharing exemplary cases from the public sector or even the private sector .... The government has also presented award certificates to individuals who contribute to the success of Smart Work Center utilization, and made a short film about it to play, for example, in the elevator, or during some conferences. We also work together with mass-media and newspapers to change this culture.”

The Smart Work Center project is expanding to meet more specific needs of certain types of employees. This includes responding to the needs of women in the workplace regarding concerns over disparities that occur when they have children. To this end, two Smart Work Centers have been planned to focus on the needs of women workers. “Recently, the Ministry of Employment and Labor initiated Smart Work Center systems in which women can work with less worries [about disrupting] their career continuity,” Dr. Jeong said.

The NIA’s goal is to expand its own Smart Work Center program to help the public sector become more efficient, and to encourage and help organizations nationwide to apply IT technologies to increase global competitiveness.

According to Dr. Jeong, along with continuing efforts to move workplace culture toward use of the Smart Work Centers, his agency is also working on increasing the number of centers – and the number of locations across the country – to help more government agencies and employees realize the benefits of improved efficiency, productivity, and employee quality of life. By demonstrating the effectiveness of the Smart Work Center system, the government hopes that the private sector will begin adopting the model as well.

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According to Dr. Jeong, implementing the project in the public sector is not only easier to accomplish, but can also provide a sort of pilot program for the private sector to emulate. "It is easier to make the transition in the public sector because the government can systematically impose and people will obey. In the private sector, there is no one to oversee or guide the process, which can easily become a waste of time."

But Dr. Jeong says they also want to go one step further. "Working at Smart Work Centers will evolve into working at home," he said. "Since 90 percent of people in Korea own smartphones, we are considering handling business via smartphone that is based on mobile functionality." The hope is that the South Korean Government will be able to capitalize on the increased productivity to an even greater degree with a work-from-home model – and that as workers' commutes are reduced to zero and quality of life improves, so will their effectiveness.

## More Information

For more information, visit http://www.smartwork.go.kr

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# Seoul TOPIS Center Harnesses IoE Capabilities to Improve Service, Efficiency, and Customer Satisfaction



**EXECUTIVE SUMMARY**

### Objective

- Efficiently provide public transportation services to all citizens based on use of Internet and technological data-gathering devices
- Improve customer satisfaction and increase usage of public transportation

### Strategy

- Transform bus system into a quasi-public operation
- Upgrade system to manage not only buses, but also all other transit-related systems (excluding traffic signals)

### Solution

- TOPIS Center manages and gathers information from all public transportation in Seoul
- Center's success derives from establishing scientific transportation policies based on collected data

### Impact

- Data collection allows Seoul City to conduct new analysis that wasn't possible before
- Bus companies benefit from establishment of fair and transparent competition system
- One-unit integrated fare program improves service by allowing bus and subway riders to use all transit systems with only one card
- Satisfaction rate for public transportation has grown from less than 50 percent to 85–90 percent

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases — how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions — federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) — to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Seoul TOPIS Center

Seoul, South Korea, seeks to efficiently provide public transportation services to all citizens based on the use of Internet and technological data-gathering devices. Through the establishment of the Bus Management System (BMS) in 2004, Seoul transformed its financially struggling bus service into a thriving backbone of the city's public transport. Cash fares evolved into the integrated one-fare card, which simplified fees for customers, and returned transparent usage and revenue data to officials for fair distribution of government subsidies. By installing sensors and global positioning systems (GPS) on buses, BMS can post accurate schedule and arrival times for riders via Internet applications.

When public transportation companies in crisis were not able to provide good service for users, more citizens took to the streets in small cars – worsenng the situation. As streets became increasingly congested and bus companies continued to suffer, Seoul City decided to transform the bus system into a quasi-public operation.

With this success, BMS was upgraded to the Seoul City Transportation Information Center (known as TOPIS Center), which is responsible managing and gathering information from all public transportation in Seoul, excluding traffic signals. Already recognized worldwide for its achievement in reducing traffic congestion and connecting passengers with real-time information, TOPIS Center credits its success to establishing scientific transportation policies based on collected data. Customer satisfaction with public transportation in Seoul has risen dramatically, not only because service has improved, but also because TOPIS Center diligently strives to share relevant data with riders.

TOPIS Center Director Kyung Soon Lee is responsible for managing all aspects of the Center, including systems and manpower for transportation and IT projects. Before moving into operational management, Ms. Lee was a team leader during TOPIS Center's planning stage.

Ms. Lee holds a doctorate degree in computer science, and is certified as both an information processing technician and a transport engineering technician. Before joining Seoul City 20 years ago,  she spent 10 years working in an IT environment at a large corporation.

## Objectives

According to Ms. Lee, TOPIS Center was born as a result of Seoul City using technology to improve the public transportation system.

"In 2004, Seoul City was planning bus system reform," Ms. Lee explained. "This was the beginning of Seoul City's transportation system renovation process. As a known problem worldwide, public transportation had been ignored due to the emergence of passenger vehicles. Consequently, public transportation companies suffered from managerial and financial crises."

When public transportation companies in crisis were not able to provide good service for users, more citizens took to the streets in small cars – worsening the situation. As streets became increasingly congested and bus companies continued to suffer, Seoul City decided to transform the bus system into a quasi-public operation.

## Strategy

To make this transition, Seoul City assumed control of bus-route management from the bus companies. To encourage greater use of public transportation by citizens, the city increased the number of buses in operation and improved services. As citizen use of public transportation grew, revenue rose for the bus companies, allowing them to offer better service. "I think Seoul's bus companies needed this type of official systematic support to maximize operational efficiency – now passengers don't wait too long at the bus stops, and they know the time when the bus is arriving. Bus riders must know the bus schedules before they come to bus stops so they can plan their times. We created this management system to control all of these elements," Ms. Lee explained. TOPIS Center was soon upgraded to manage not only the bus systems, but also all other transit-related systems (excluding traffic signals).

"When there is an emergency, our Center moves the quickest. For example, if heavy snow, heavy rain, or a landslide is reported to the EM Center, this information gets passed to the TOPIS Center immediately so we can take action, such as announcing closed routes in real time, or which area to avoid. You can call it a fusion of systems or cooperation."

Kyung Soon Lee,
Director,
Seoul TOPIS Center

Seoul City is the key stakeholder in this project. "As of now, Seoul is the first city that has implemented or executed the quasi-public system," Ms. Lee said. "Other local governments consider it a benchmark, and they copy this system with the help of the central government." According to Ms. Lee, TOPIS Center is under the auspices of Seoul City's mayor because it was constructed by the city government, not by the central government.

According to Ms. Lee, all funding came from the city itself: "Seoul built this system autonomously," she asserted. "There was no joint venture effort or public-private partnership. Seoul City government didn't receive any funding from the central government." However, officials were able to use the Seoul City government budget to fund bus companies by supplementing their revenues.

The ability to track bus revenues and ridership has been crucial in understanding the operating success of each of the bus companies. Characterizing the information as a check on their performance, Ms. Lee indicated that TOPIS has allowed the city government to verify the efficacy of their transportation subsidy dollars.

In 2013, TOPIS began integrating with Seoul Emergency Management Center. Integration of operational areas is in process, and integration of software applications is yet to come. Both Centers now share the same location, which makes sense because they can collaborate to resolve problems and communicate with transit customers. "The physical integration already works in favor of all of us," Ms. Lee explained. "When there is an emergency, our Center moves the quickest. For example, if heavy snow, heavy rain, or a landslide is reported to the EM Center, this information gets passed to the TOPIS Center immediately so we can take action, such as announcing closed routes in real time, or which area to avoid. You can call it a fusion of systems or cooperation."

## Solution

In terms of structure, this project involved gathering data from a number of sources – streets, buses, taxis, and citizens – using GPS devices, loop detectors (under-pavement vehicle detection), road sensors, video, CCTV, and reports from drivers and riders. "The information collected from these devices gets transmitted to our Center [via Wi-Fi and data networks]," Ms. Lee explained. "The Center utilizes various algorithms and analyses to disseminate bus-arrival times for all buses, which are posted on a smartphone app, bulletin board terminals at each bus stop, and on the web portal. All information is offered to citizens via all means possible." Riders have access to data that helps them schedule their routes and choose which buses to ride 24 hours a day.

Enormous amounts of data from road and video sensors, GPS, taxi cab credit card readers, citizen and driver reports, Wi-Fi networks, CCTV, and unattended surveillance devices are processed by the Center's databases. This real-time information is then distributed to citizens via smartphone apps, signboards at bus stops, and a web portal.

This data also facilitates the city's decision-making and enforcement of transit rules. "Within the Center, we create modeling utilizing received data from riders or drivers and any transit-related sources," Ms. Lee said. "This is used to make decisions regarding transportation-related policies, and to prioritize work orders for route changes and improvements." Using unattended surveillance, officials can issue citations for parking and driving violations. As integrated transit fare cards replace cash fares, bus companies and transit officials can also track passenger usage and allocate revenue to specific companies. Passengers can use a single card to complete their journeys, thereby avoiding being charged for transferring from buses to subways, for example. In this way, TOPIS Center data not only improves service for public-transit users, but it also provides transparency for officials who can issue violations using unattended surveillance, monitor passenger usage, and determine funding subsidies for bus companies.

The initial public transportation management and data flows are already in place and working successfully. TOPIS Center is beginning to identify bus-load capacity. "As riders scan their bus cards and bus location, information is received from BMS," Ms. Lee explained. "Utilizing these two pieces of information, we create one new process to provide citizens with information about how crowded specific buses are, so riders can choose their buses accordingly." This aspect of the project is currently in process.

In a public transportation system where citizen engagement was once minimal, Seoul City public transit now offers excellent methods for communication between riders and officials. Ms. Lee says that citizens are encouraged to communicate with TOPIS Center via Internet and smartphone applications, and via telephone by calling 1-2-0. "This is the main number that belongs to Seoul City. People can call from anywhere or anytime. We resolve issues immediately," Ms. Lee explained.

Enormous amounts of data from road and video sensors, GPS, taxi cab credit card readers, citizen and driver reports, Wi-Fi networks, CCTV, and unattended surveillance devices are processed by the Center's databases. This real-time information is then distributed to citizens via smartphone apps, signboards at bus stops, and a web portal. Riders can plan efficient routes based on traffic information, locate parking spots, and learn when buses will be arriving. This information also benefits city officials, who use it to inform policies, plan route improvements, clear up road congestion, and issue violation notifications.

## System Architecture and Design

According to Ms. Lee, system architecture and design is divided into three parts: 1) the field area, 2) the Center itself, and 3) citizen services.

First, the field area includes sensors mounted on the road, OBU (on-board units) installed in the vehicles, Wi-Fi systems transmitting data from those devices, and the CCTV video system and its control system. These devices help gather and transmit relevant data from roads and vehicles to the Center for processing.

Second, at TOPIS Center, "main servers have database management systems. Main servers operate in dual system for nonstop operation," Ms. Lee explained. The Center is the hub for analyzing and organizing data using several web servers and databases, and then disseminating it for official and citizen use.

Third, in terms of citizen services, this project enables riders to access data using smartphones or Internet devices, or at bus stops. "We built our server in open API to allow the general public or businesspeople to download necessary data," Ms. Lee explained. "An example of direct (immediate) service to citizens is the Bus Information Terminal (BIT), which is installed at each stop and displays the arrival times of buses. We also installed Variable Message Signs (VMS) along the roadways so drivers can obtain necessary traffic information."

"Citizens are connected to TOPIS Center via three applications. Additionally, both citizens and transit-related business organizations have access to our location information."

Kyung Soon Lee,
Director,
Seoul TOPIS Center

## User Applications

After gathering and analyzing a wealth of data, TOPIS Center also connects Seoul residents with transportation data via three specific, Internet-based applications. First, a public transportation service application called SeoulPublicTransportation offers information in real time regarding any form of public transit – such as buses, subways, or railroads – that passes through Seoul City. "The app shows the location of all transportation means, and users can locate the one they need," Ms Lee explained. "For example, let's say a citizen needs to be somewhere after midnight. She or he can search for available transit in real time. Recently, we opened a 24-hour bus service and it became our most popular program." This app helps riders locate buses that pass every 40 minutes after midnight and plan their schedules to minimize wait time. Since this app meets an important and previously unmet public need, it has generated significant support for TOPIS.

Second, a relatively new app called Seoulppaleungil (translated as "Seoul's fastest way") delivers traffic information in real time for main highways around Seoul's central business district areas, including all city routes. Ms. Lee describes Seoulppaleungil as "popular because it shows the fastest route for getting from place to place." Since traffic conditions are constantly in flux, this app makes a difference minute by minute.

Third, the Seoul traffic portal site not only combines the functions of the two applications described above, but also allows users to search in real time for parking spots, public-use bicycle areas, and car-sharing spots.

Ms. Lee summarized the combined effect of this technology: "Citizens are connected to TOPIS Center via three applications. Additionally, both citizens and transit-related business organizations have access to our location information."

These three applications promote positive public relations, and they increase citizen and business awareness of the Center's efforts.

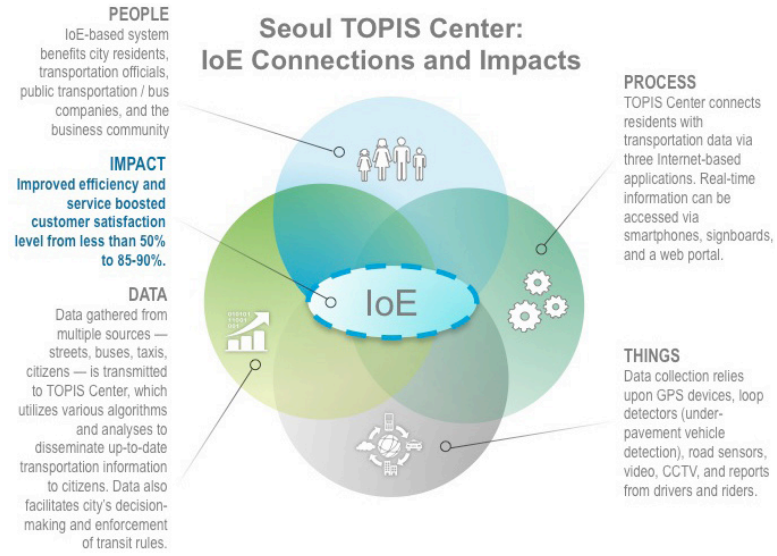
User experience has changed substantially as a result. Now, riders can plan routes faster and more accurately than before. Beyond the roadway, the citizen services aspect of system architecture also includes the construction of specific link servers designed to connect with other servers to download necessary information.

These three main benefits show up in the creation of data-based transportation policies, the establishment of fair and transparent competition for bus companies, and the reduction of citizen traffic complaints.

### Surveillance

Technology also advances the process of surveillance. For example, Ms. Lee explained, "we have two bus lanes: median lane and curbside lane. If any other vehicles enter those lanes, it constitutes a violation. Usually drivers follow the rules very well, but we established a surveillance system to crack down on offenders. First, CCTV is installed to videotape the violation. Then, our Center uses filtering functions to single out the offending vehicle according to individual plate number, which is stored in the system." After TOPIS Center uses technology to catch the offense and identify the offender, it connects with servers in another facility, which imposes the fine, and a third facility notifies the citizen of the ticket.

**Figure 1.** Seoul TOPIS: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

Ms. Lee notes that public satisfaction with TOPIS has been very high, and she credits this in part to the added transparency and information that is available to Seoul residents and those who utilize the transportation system.

"There is a saying in Korea that means, loosely, 'We caught three bunnies at once.' This is definitely the case here," Ms. Lee explained. These three main benefits show up in the creation of data-based transportation policies, the establishment of fair and transparent competition for bus companies, and the reduction of citizen traffic complaints.

First, gathering data allows Seoul City to conduct new analysis that wasn't possible before the public sector established scientific transportation policies. For example, Ms. Lee explained how the Center analyzes Big Data collected from credit-card readers in taxis: "Our system receives credit-card data from 30,000 taxis every 10 seconds," she said. "We are talking about 7.6 billion data points collected per year. We can produce Seoul City's transportation information deliverables (i.e., planning and analysis documents) using those 7.6 billion Big Data points collected from taxis .... As for the future transit system, we want to be able to forecast by utilizing this accumulated past data. To do this, we are in process of making an arrangement with the central government's R&D team." Validating current and future policies with data increases the city's ability to provide for citizens' transit needs, and minimizes room for corruption.

"So, it is a *win-win-win* situation, not win-win. I think our system satisfies the citizen, public sector, and bus companies."

Kyung Soon Lee,
Director,
Seoul TOPIS Center

Next, Seoul's bus companies benefit from the establishment of a fair and transparent competition system. One of the biggest issues that city officials and the bus companies had to solve was related to bus revenues and government subsidies. Before TOPIS Center, riders used cash to pay bus fares, and the drivers provided change when needed. "Since the revenues were in cash," Ms. Lee explained, "it was very difficult to figure out how bus-fare revenues should be allocated for each company." When Seoul City began giving out financial assistance to companies with low revenues, the government needed data to evaluate recipients of this subsidy impartially. In the past, according to Ms. Lee, there had been some cozy relations between government officials and business organizations, but, with the 2004 transportation system innovation, data collection facilitated policy without corruption.

To establish a transparent revenue system, TOPIS Center created the one-unit integrated fare program, in which bus and subway riders can use all transit systems throughout the city with only one card. This improved citizen services because riders don't pay extra fees when transferring between subways and buses on the way to their purchased destination. These fare cards also provide tangible data regarding bus company revenue, thereby supporting the fair distribution of government funds (Oil Price Subsidy) available to bus companies. "The transparent fare system and high-quality services enabled the government and the bus companies to work together to manage bus transit, drivers, and fares," Ms. Lee said.

Finally, as transit operation increases in efficiency, customer satisfaction also rises. "Scientific operation of transit affairs has reduced citizen traffic/transit complaints dramatically, compared with the past, when more than 90 percent of civil complaints were about transportation," Ms. Lee reported. "Now not many complaints are received, and the satisfaction rate for public transportation has grown from less than 50 percent to 85–90 percent." The Seoul transportation system has achieved global recognition, and TOPIS Center has become a benchmark for other public sectors. "So, it is a *win-win-win* situation, not win-win," Ms. Lee stated. "I think our system satisfies the citizen, public sector, and bus companies."

"We'd like to be a leader in transit management systems. So, we love to support other countries, such as underdeveloped countries or jurisdictions that need help sorting out transit problems. If there is an opportunity to share our expertise and experiences with others, we welcome it."

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## Lessons Learned / Next Steps

Every project has a learning curve, and Seoul City's transportation upgrade is no different. In the process of implementing such extensive innovation in the transit system, TOPIS Center has overcome many challenges. "In establishing our TOPIS Center, we had numerous cases of trial and error," Ms. Lee explained. "For instance, one sensor that we'd selected was not the best fit for our system technologically. Sometimes policies were against us, and we didn't have the right technical environment. For TOPIS Center to be this sophisticated, we went through many hurdles."

Some of these obstacles involved negotiating with bus companies toward fair and transparent management practices, revenue allocation, and fund distribution. Others related to mapping out specific projects and devising new software applications to fit. Often, Ms. Lee faces a shortage of IT manpower – Seoul City wants to implement various projects but cannot supply sufficient, qualified workers.

In terms of future plans, Ms. Lee affirms TOPIS Center's interest in supporting other countries in building effective transit systems. "We'd like to be a leader in transit management systems," she said. So, we love to support other countries, such as underdeveloped countries or jurisdictions that need help sorting out transit problems. If there is an opportunity to share our expertise and experiences with others, we welcome it."

Currently, TOPIS is collaborating with the World Bank and ADB (Asia Development Bank) to support other Asian jurisdictions and countries that want to visit the Center. Current projects are advancing along the trend of collecting and analyzing Big Data to inform future policies and improvements, and Seoul is making arrangements with the central government for assistance with research and development.

# *Connecting Sichuan* Leverages IoE Capabilities to Improve Healthcare and Education



## EXECUTIVE SUMMARY

### Objective

- Build a connected community from the ruins of the 2008 earthquake
- Use technology to improve healthcare, education, and economic development
- Create scalable, replicable models for technological innovation

### Strategy

- Working within a public-private partnership, incorporate ICT into the disaster rebuilding effort

### Solution

- Connected ICT infrastructure encompassing cellular, satellite, and a variety of broadband technologies
- Healthcare initiatives include mobile device connectivity, Mobile Clinics, and networked medical facilities
- 21st Century Schools initiative uses digital technology for distance learning, shared content, multimedia instruction, and teacher development

### Impact

- Improved access to medical care through Mobile Clinics, 32 new "smart" hospitals, 66 networked medical facilities, and streamlined medical administration
- Networked campuses and remote learning improve educational opportunities for students and teachers
- Technology in the classroom supports long-term economic growth

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Connecting Sichuan

A violent earthquake and series of aftershocks in 2008 devastated parts of Sichuan province in China, killing 80,000 and seriously injuring hundreds of thousands. The disaster left many homeless, while decimating schools and healthcare facilities. Connecting Sichuan — a public-private partnership that is unique in China — tackled technological rebuilding and revitalization of the area. The project was a three-year effort incorporating state-of-the-art information and communications technology (ICT) infrastructure throughout the rebuilding process. Its threefold approach addressed healthcare, education, and economic development by preparing youth to enter the future as a technologically progressive generation.

Qiang Liu is president of the Shifang Traditional Chinese Medicine Hospital within Sichuan's medical network. He also serves as director of the Shifang Health Bureau Information Center.

The Connecting Sichuan project sought to build a uniquely connected community with state-of-the-art technological infrastructure designed to promote locally sustainable growth of healthcare and education.

## Objective

The Connecting Sichuan project sought to build a uniquely connected community with state-of-the-art technological infrastructure designed to promote locally sustainable growth of healthcare and education. In addition to the structural rebuilding of the area, the project managers consciously incorporated technology into the rebuilding, with a particular focus on the outcome, rather than just product deployment. The rebuilding effort provided an ideal proving ground for technological innovation. Provincial and central Chinese government leaders were interested in seeing how rebuilding could be used to incubate solutions for replication in other parts of China.

## Strategy

Connecting Sichuan is a public-private collaboration in which the government of China committed more than $145 billion to the overall Sichuan earthquake rebuilding effort. In addition, a major global technology company provided infrastructure technology and services. The program's threefold strategy focused on applying technology to improve healthcare, education, and long-term economic development in the area.

Mr. Liu indicated that the Connecting Sichuan project involved local medical administrators from the early stages of development. "From the beginning, our designs for reconstruction after the earthquake were coordinated with the Connecting Sichuan project," he explained. "The network design was specifically reflected in the overall plans, ensuring that different medical facilities, patient rooms, and buildings were all connected."

## Solution

### Telecommunications Infrastructure

A connected ICT infrastructure was a key dependency for the other Connecting Sichuan initiatives. To reestablish communications as soon as possible following the earthquake, the government established multiple avenues of connectivity, including cellular, satellite, and a variety of broadband technologies.

The first thing the government established was the mobile or wireless network in the earthquake region, making Sichuan one of the first regions with pervasive 3G network availability. Along with a focus on road and building reconstruction, the project addressed the need for a robust ICT infrastructure, such as fiber optics along roads and ICT equipment in medical and educational institutions throughout the province. In Wenchuan County, the worst-hit region, the government established 150 endpoints using the local cable TV network's broadband. Together, these efforts connected Sichuanese communities to both internal resources and those outside the province, helping to stimulate economic growth.

Along with a focus on road and building reconstruction, the project addressed the need for a robust ICT infrastructure, such as fiber optics along roads and ICT equipment in medical and educational institutions throughout the province.

### Healthcare Initiatives

Following the earthquake, a top priority was to bring medical care to the vast numbers of injured survivors, many in remote villages that were hours from the nearest hospital or clinic. While delivery of urgent medical services was the impetus for the program, it was designed around the community's longtime need to reduce the cost of healthcare delivery while increasing the quality of medical services. The new system made use of network telecommunications, cloud-based and centralized data management, and mobile technology to fundamentally change the delivery mechanism for healthcare.

In addition to stretching valuable medical resources, smart hospital technology uses the network to streamline administrative tasks and enable physical security, building management, energy utilization, and even air conditioning — all the different aspects of the hospital physical environment.

#### *Mobile Device Connectivity*

Immediately following the earthquake, medical field staff used mobile devices to map disease outbreaks, a common public health issue in disaster situations. With compromised transportation and communication systems, the key challenge was determining how to monitor for disease and intervene quickly. With widely deployed mobile devices, public health workers were able to capture disease information in the field and send it to the Centers for Disease Control and other public health agencies. The CDC could then use analytics to pinpoint the outbreak and respond appropriately.

#### *Mobile Clinics*

A fleet of Mobile Clinics was deployed to provide urgent care to areas that had been cut off by the earthquake. A Mobile Clinic is a four-wheel-drive vehicle capable of negotiating the rough terrain of hillside villages, and configured to provide basic medical services and consultations. The vehicle is equipped with radiology diagnosis equipment, an ultrasound unit, and laboratory capabilities, as well as a

consultation room with telehealth capabilities, including video, audio, and data links. Multiple connectivity technologies – including a satellite-based communication gateway for remote areas – provided reliable connectivity during subsequent serious aftershocks. The vehicles also have microwave connectivity and a 3G gateway to allow voice and database connectivity.

When Mobile Clinics travel from village to village, they provide onsite examinations and testing, as well as video conferencing that allows city doctors to provide remote consultations to clinic visitors. The most widely used connectivity is between the Mobile Clinics and township medical centers, through which the Clinics connect with the centers' broadband services.

The vehicles were instrumental in restoring medical care and providing essential medical services in the aftermath of the quake. They have since become a permanent extension of Sichuan's hospitals, providing onsite care and linking rural villages with distant providers and other resources available at large medical centers.

The telehealth technology built into the new smart hospitals allows for remote patient consultations, while collaborative events such as professional consultations are conducted via video conference .... Hospitals are no longer isolated, and previously underserved areas of the province now have access to all of these institutions.

### *Networked Medical Facilities*

Thirty-two new "smart" hospitals were constructed or reconstructed as part of the project, extending ICT to all 66 medical facilities in the region. ICT has become the backbone of care delivery for the region, which does not have enough qualified doctors to adequately staff all of its medical facilities.

The telehealth technology built into the new smart hospitals allows for remote patient consultations, while collaborative events such as professional consultations are conducted via video conference. Patient data and other medical information are shared among these and 66 other provincial medical centers, which now have broadband network connectivity and video-conferencing equipment. A cloud-based data center connects them all together. For example, doctors in various locations work with each other on case studies, remote consultations, or remote radiology readings. Hospitals are no longer isolated, and previously underserved areas of the province now have access to all of these institutions.

Self-sustainability of the hospitals and clinics was important from the start. Mr. Liu noted that at present, roughly 90 percent of the ongoing technological support for the ICT infrastructure within his hospital is done internally, while the remaining support is contracted to partnering technology companies. Hardware and software support is all provided by local Chinese firms.

## Educational Initiatives

The primary goal of the Connecting Sichuan educational initiative was replacing schools lost in the earthquake with "21st Century Schools" incorporating state-of-the-art ICT and digital technology in the classroom. Objectives for the structures included a networked educational community with shared instructional content; increased learning options through remote classroom activities; curricula supported with multimedia presentations; and teleconferencing events to provide teachers with opportunities for professional development.

The first step in the educational portion of the Connecting Sichuan initiative was providing ICT to create a connected campus. Connectivity is critical to a 21st-

century classroom, in which curricula and teaching strategies are shared using a cloud-based approach. In this system, master teachers provide smaller schools with access to a variety of classes and professional support. For example, a teacher in the capital city of the province can teach a class that is broadcast to other schools in the earthquake zone, and the students can participate in back-and-forth interaction with the teacher. Additional course options, improved curriculum, and wider access to the most highly skilled teachers are particularly valuable in rural villages.

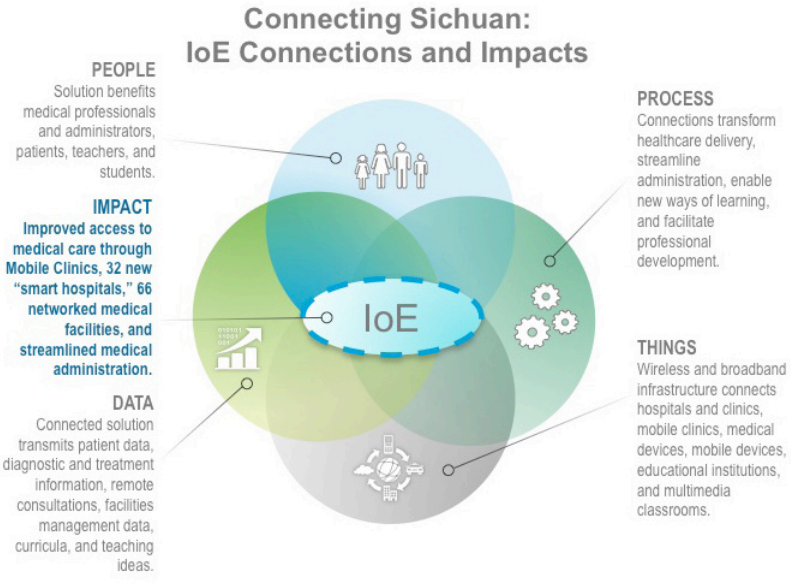
Smart classroom installations occurred primarily in quake-ravaged areas, but audio-visual connectivity was extended to areas beyond the quake zone as well, providing additional educational opportunities and professional support in remote school systems. ICT equipment and use vary by the needs of each class, ranging from voice- or portal-based connections, to telepresence capabilities, to more immersive environments. Digital whiteboards have also replaced traditional chalkboards.

The program was not just about providing devices or equipment — it also involved working with schools and teachers to incorporate technology into their teaching methods.

The program was not just about providing devices or equipment — it also involved working with schools and teachers to incorporate technology into their teaching methods. As a result, teachers not only receive a whiteboard — they also benefit from training on how to use it and incorporate it into their curriculum. The program established provincial- and county-level educational clouds, which enable teachers to download training and other materials. Telepresence sites in 26 locations put teachers in close contact with mentors and senior educators in a virtual professional development network.

To a certain extent, the program is a greenfield initiative and serves as a valuable test site for educational models. It provides the opportunity to experiment and capture the impacts of policy or process change, as well as of technology deployment.

**Figure 1.** Connecting Sichuan: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

The Connecting Sichuan program has been widely recognized as a model of both disaster response and smart community design.

### Healthcare Initiatives

One of the primary goals of the Connecting Sichuan program was to provide long-term and sustainable change in healthcare delivery, addressing the shortages of trained medical professionals and limited access to quality care in remote communities. Building or rebuilding 32 smart hospitals, networking 66 medical facilities, and providing mobile delivery of healthcare services have made these objectives a reality for millions of Sichuan residents and medical providers.

#### *Mobile Clinics and Telehealth*

The Mobile Clinics have proven a highly effective tool within the Sichuan medical community, and the program has grown well beyond the initial deployment. Additional Mobile Clinics have been put into use not for disaster response, but as an extension of hospital services to remote areas such as the ethnic Tibetan region of the province. The Mobile Clinics are providing health screenings and bringing patients to hospitals for treatment.

The Mobile Clinics have proven a highly effective tool within the Sichuan medical community, and the program has grown well beyond the initial deployment ... Additional Mobile Clinics have been put into use not for disaster response, but as an extension of hospital services to remote areas.

In addition, the proliferation of mobile devices and telecommunication technology assists with identification and management of disease outbreaks, providing real-time support for field personnel from the Centers for Disease Control.

#### *Smart Hospital Networking*

Connecting scores of hospitals and medical centers has promoted consistency and quality of service. Access to common cloud-based medical and patient data, professional development training materials, remote specialist support, and quick consultations with distant colleagues creates an environment of collaborative patient care. It encourages ongoing treatment of chronic conditions and results in improved patient outcomes. These contributions are particularly important in rural communities.

#### *Streamlined Medical Administration*

Mr. Liu also stressed that the new technological infrastructure vastly improves the efficiency of hospital processes. It streamlines patient intake and management, and decreases wait times by bringing centrally stored information to the right person at the right time. For example, patient test results are now available online, instead of doctors or patients having to retrieve hard copies or evaluation. The information flow also allows for easy calculation of doctors' performance reviews and workloads. Additionally, the system easily tracks and analyzes consumption of medical supplies and other materials.

While the infrastructure upgrades incur up-front and maintenance costs, they do not directly increase revenue. However, it is believed that reduced patient wait times and other efficiencies may indirectly affect revenue.

Another goal of the Connecting Sichuan program was to create a model for future community development programs. A group of academic researchers from Peking University, led by top health economics professor Gordon Liu, conducted a household-based, data-driven evaluation of the impact of Connecting Sichuan's healthcare initiatives. The peer-reviewed study, "Transforming Rural Healthcare Through Information Technology: an Interventional Study in China," appeared in the journal *Health Policy and Planning,* published by Oxford University Press. The study identified a number of successes in the program, and provided the following conclusion:

> *Connecting Sichuan was designed to systematically transform healthcare, education, and the workforce through networking technology. The Connecting Sichuan partnership has been a springboard for innovation and an incubator for the development of sustainable, replicable, and scalable technology models in Sichuan and beyond.*

Technology-based classroom interactions also fulfill one of the objectives of Connecting Sichuan: educating a technology-savvy generation to assist in the area's long-term economic recovery.

### Educational Initiatives

The educational environment of the 21st Century School includes advantages for both teachers and students. Networked campuses promote anytime, anywhere interactions among students, teachers, and senior educators, supporting engagement by all campus participants. Remote learning opportunities, shared instructional tools, and multimedia content in the classroom provide additional resources for teachers and a richer learning experience for students.

Technology-based classroom interactions also fulfill one of the objectives of Connecting Sichuan: educating a technology-savvy generation to assist in the area's long-term economic recovery. The early exposure to technology not only helps students learn the content, but also helps encourage critical thinking and the ongoing study of technological fields.

## Lessons Learned / Next Steps

Mr. Liu described some early resistance to Connecting Sichuan programs within the medical community, saying that initially, "a lot of people weren't familiar with the system, and opposed it." He explained that some opposition originated with the staffs of newly built medical centers, but that "the opposition phase has already passed. These people have seen the benefit, and now very few people are against it." Among the few holdouts are some senior physicians who struggle with any kind of technology. To address the problem, Mr. Liu engages staff to assist the physicians with tasks such as ordering online prescriptions.

To help overcome objections and train users in the new technologies, Mr. Liu relied heavily on the Information Center, a service center organized as part of the Connecting Sichuan strategy. He described the center as an invaluable resource during implementation and training phases. "Its goal was to provide information support to medical organizations in our area, as well as strategic planning," he explained.

Mr. Liu's biggest challenge going forward is maintenance support. "After all," he said, "this equipment will depreciate and run into problems, and it requires staff to maintain." However, Mr. Liu is hopeful for the long-term success of the program. He continues to adjust systems to optimize usage of the technology and increase efficiency. "Our plan right now is to enrich our application systems," he said. "We will develop numerous applications based on our medical organizations' business or management needs in Shifang city. We hope to make management easier, improve efficiency, and have the general public enjoy the benefits of the system."

The Connecting Sichuan initiative offers a model that can be replicated elsewhere – not just within China, but wherever access to healthcare and educational resources needs to be more efficient and widespread.

Local sustainability is also an issue requiring policy changes, particularly regarding reimbursement for some procedures. For example, if a doctor provides remote support and is not reimbursed, then the system is not sustainable. Local governments and rural health insurance entities will need to adjust policies and processes to support the change-management process.

While the project began as a public-private partnership, it is now in the hands of local authorities who are continuing to manage and expand the program. The Connecting Sichuan initiative offers a model that can be replicated elsewhere – not just within China, but wherever access to healthcare and educational resources needs to be more efficient and widespread. While there have been other successes in telehealth and distance learning, the timing of the Sichuan deployments – coinciding with an increased governmental focus on health reform – bodes well for the long-lasting impact of the Connected Sichuan initiative.

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# Singapore Employs IoE Connections as Foundation for "Smart Nation" Vision



## EXECUTIVE SUMMARY

### Objectives

- Leverage ultra-high-speed, pervasive, intelligent, and trusted "infocomm" infrastructure as foundation to become world's first Smart Nation
- Create globally competitive infocomm industry to foster innovation
- Develop infocomm-savvy workforce
- Spearhead transformation of key economic sectors, government, and society through more sophisticated and innovative use of telecommunications

### Strategy

- Work closely with citizens, businesses, and educators to create and implement Intelligent Nation master plans

### Solutions

- Next-Generation Nationwide Broadband Network provides ultra-high-speed connectivity to 99 percent of residents
- Wireless hotspots provide Internet-based services in areas frequented by students, tourists, professionals, and business travelers with portable devices
- Shareable infrastructure for sensing technology enables applications for healthcare, transportation, supply chain, logistics, and other areas

### Impact

- Nearly ubiquitous connectivity
- Improved efficiency
- Interoperability of strong industry players
- Improved synergy of public and private sectors

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Singapore's Technology Journey

As a relatively young nation since achieving independence in 1965, Singapore has developed into an economic powerhouse and continues to grow and innovate as a world-class hub for trading and logistics, smart manufacturing, and biomedicine. Singapore has become a regional business headquarters for modern services ranging from finance to IT. Since 2006, the World Bank has consistently ranked Singapore as the top location globally for ease of doing business. A stable, trusted, and pro-business environment has allowed innovation to flourish in the tiny city-state.

**Technology Innovation.** Singapore's progress as a technology hub is particularly impressive, growing from a mere 850 IT professionals in 1980 to nearly 150,000 in 2013. This has been accompanied by a seven-fold jump in computer adoption by firms – from 13 percent in 1982 to 96 percent in 2013.

Implementing technology strategies in 10-year spans, the Singapore Government has so far connected nearly 99 percent of its residences to an ultra-high-speed fiber-optic network.

Singapore also enjoys a high mobile penetration rate of 156 percent. Singapore has been ranked second globally for five consecutive years in the Global IT Report by the World Economic Forum, and ranked first in the "Environment Index," which evaluates how well a country's market and regulatory framework supports information and communications technology (ICT) uptake, entrepreneurship, and innovation. Singapore also topped the "Impact Index," which gauges the broad economic and social effects of ICT in boosting competitiveness and well-being. In 2014, the country launched a S$500 million program, ICT for Productivity and Growth, to further accelerate the adoption of technology solutions among companies to boost their growth.

**ICT Master Plans.** The Infocomm Development Authority (IDA) is charged with developing information technology and telecommunications within Singapore, with a view to serving citizens of all ages and companies of all sizes. It uses ICT master plans worked on in collaboration with Singapore's Ministry of Communication and Information, as well as industry leaders, to chart the vision for Singapore's information and communications ("infocomm") sector. IDA then aligns its activities to these plans, and in so doing actively supports the growth of innovative technology companies and startups; engages with leading global IT companies; and develops superior information technology infrastructure, policies, and capabilities for Singapore.

Singapore's current vision to become the world's first Smart Nation grew out of its last plan, the Intelligent Nation 2015 Master Plan. The country continually seeks to encourage a technology-savvy public, promote technological education, and support industrial development and entrepreneurial interests. Implementing technology strategies in 10-year spans, the Singapore government has so far connected nearly 99 percent of its residences to an ultra-high-speed fiber-optic network. As part of its Smart Nation vision, Singapore is now in the midst of planning and deploying a pilot version of a mesh network of sensors nationwide that will provide advanced data gathering and analytics capabilities to improve operations in healthcare, logistics, and other key sectors.

## Objectives

**The World's First Smart Nation.** The technology-savvy city-state is now implementing a bold plan to be the world's first Smart Nation, underpinned by the use of data and analytics to improve people's lives. It is leveraging the capabilities of its world-leading open access fiber network; expanding the intelligent infrastructure to street-level coverage with new aggregation-gateway boxes for an integrated sensor-rich network; and exploring a new heterogeneous network across fixed and mobile infrastructures. This is coupled with a new Smart Nation Operating System that enables anticipatory government and city services, and empowers citizens with rich data insights to improve their lives. With a robust and future-proof infrastructure foundation, Singapore hopes to pioneer a new tech industry in Smart Nation capabilities. This will include developing creative talent in data analytics and other disruptive technologies, such as smart robotics, the Internet of Things (IoT), Big Data, cloud computing, and so forth. The program is also coordinating with initiatives in the areas of governance, data protection and sharing, and cybersecurity. Early pilots have been conducted in the Jurong Lake District, and nationwide deployment will be completed under the new Infocomm and Media Masterplan over the next few years.

IDA looks at how technology can transform sectors—such as healthcare or logistics—before zooming in on pertinent areas for further research.

**Moving Toward a Maker Culture.** The IDA has championed new initiatives for technology companies. The IDA Labs provide startups with an environment to prototype, experiment, and collaborate to build products and solutions that address real-world challenges. Innovative products by early-growth tech companies are also given crucial help via *Accreditation@IDA* – a scheme to build their credentials and be in a better position to win projects with government agencies and large enterprises. IDA's Accelerator program further promotes a vibrant startup community by helping promising companies to scale and grow globally. Overall in 2013, a total of US$24.7 billion in venture capital funding went to Singapore-based tech companies, according to the *Asian Venture Capital Journal* (including government, private, and angel funding). Singapore is ranked in the top 20 in the Startup Genome Report's Startup Ecosystem Index. Total infocomm industry revenue grew a robust 45 percent year-over-year, from S$102.46 billion to S$148.11 billion in 2013.

## Strategy

On a broad scale, Singapore's master plans are about transformation of the entire nation. IDA's approach, therefore, extends beyond government services. IDA looks at how technology can help transform sectors – such as healthcare or logistics – before zooming in on pertinent areas for further research.

### Trend Sensing

Master planning requires a keen grasp of current and future technological trends to predict how the world will be in a decade. It requires careful study of macroeconomics as well as short-term and medium-term trends. Technology changes are occurring so quickly that even the IDA admits it has to continually fine-tune its assessments. If a technology or its adoption moves faster than anticipated, the IDA adjusts its plans accordingly.

In addition to technology adoption, the IDA also considers socioeconomic patterns in the master plans. Singapore understands that its small size, finite labor force, and aging population mean it must rely on technology to improve productivity and efficiency. Where possible, therefore, the nation encourages automating work to free up labor for higher-value jobs.

## Educational Support

To promote technological interests within the country, IDA sponsors the Infocomm Club Programme, which encourages students in primary education, secondary education, and junior colleges to pursue infocomm-related studies. IDA also offers undergraduates the Enhanced Learning in Information Technology (ELITe) program, which mentors infocomm students and provides work and sponsorship programs following graduation. In addition, IDA presents the IDA Junior College Computing Award to students demonstrating aptitude in the computer sciences, and the Integrated Infocomm Scholarship for those at the polytechnic and university levels.

## Industry Development

To encourage infocomm startups, IDA offers an accreditation program to provide visibility and a competitive edge to promising, early-growth technology companies. According to the IDA website, the program provides these companies "the credentials that will speed up their go-to-market strategy and secure customers and partners, including the government and large enterprise buyers."

Singapore understands that its small size, finite labor force, and aging population mean it must rely on technology to improve productivity and efficiency.

The accreditation program looks at an early-growth tech company holistically, before deciding if it meets the criteria to be accredited. Should a company fail to meet the standards, it still gains valuable feedback about what it should do before applying again. Companies that receive IDA's accreditation are then considered first, where relevant, for innovative technological government projects. In the Smart Nation vision, these companies would not only enhance the country's technological and business environment, but also offer successful solutions for Singapore to offer to a global market.

Singapore has also recently established a set of labs to encourage small and medium-sized businesses and startups. These labs allow different companies and groups of people to gather, explore and germinate new ideas. This meeting point brings together researchers and universities, companies and designers to help exchange and generate new product ideas. The nation's efforts have paid off: Google and Amazon are opening new facilities in Singapore as a result of the country's advanced ICT ecosystem.

## Additional ICT Support

Other IDA measures include the Partnership for Capability Transformation (iPACT), which works to strengthen relationships among businesses in the ICT community. IDA works closely with the IT industry to identify and follow international standards, and encourages manufacturers in marketing Singapore's ICT exports.

IDA also offers a variety of programs that provide funding, education, and support for technology that increases productivity, such as e-commerce consulting for the shipping, trucking, and retail industries.

## Solution

### iN2015 Master Plan

*Next-Generation Broadband Infrastructure*

Singapore's Nationwide Broadband Network (NBN) is a fiber-to-anywhere project that currently connects 99 percent of the residents of Singapore to an ultra-high-speed network via cabling, as specified in the country's iN2015 ICT master plan. The NBN is designed, according to iN2015, "to transform Singapore into an intelligent nation and a global city, powered by info-communications." A network of private partners provides home- and business-based services..

Singapore's Next-Gen NBN project is evidence of how the public and private sectors in Singapore work together toward innovation. First, the Singapore government pledged S$250 million (roughly US$200 million) for installation of the Next-Gen NBN infrastructure. Private providers assumed the remainder of the costs associated with installation and maintenance. Now complete, the infrastructure is entirely owned and managed by the private providers who installed it.

There were more than 550,000 Next-Gen NBN subscribers as of June 2014. The base has more than quintupled since January 2012, and there is a growing proportion of consumers on 100-Mbps plans or higher.

The Nationwide Broadband Network is designed, according to iN2015, "to transform Singapore into an intelloigent nation and a global city, powered by info-communications."

*Transfer Speeds*

The NBN provides download transfer speeds of up to 1 Gbps and upload speeds of up to 500 Mbps, with advertised speed capacities occurring 99 percent of the time. International download speeds also run up to 1 Gbps, with upload speeds up to 500 Mbps. It also has "an assured minimum international download speed of 30 Mbps during peak hours," according to one provider. These speeds become critical for many industries in Singapore, and such high-speed data services are how Singapore helps maintain its competitive edge in developing its finance, software/engineering, data center, and gaming industries.

### Wireless Hotspots

In addition to the broadband network, the iN2015 National Infocomm Infrastructure initiative includes the establishment of wireless hotspots throughout the country. Known as Wireless@SG, this program offers Internet-based services in areas frequented by students, tourists, professionals, and business travelers with portable devices.

*Providers*

Wireless@SG service is offered by a federation of private service operators, allowing subscribers to use hotspots operated by different service providers seamlessly with the same credentials. Wireless access is granted upon registration. Registrations are available through online web pages and more recently via SIM Card authentication. Passwords are issued via SMS to mobile phones or through provider-operated customer service centers.

*Security*

Upon registration, users can connect at any hotspot within the coverage area regardless of the operator network. Login methods include SIM-based authentication (EAP-SIM), Seamless and Secure Access (WPA2), and HTTP-based Login (Captive portal). Users are encouraged to take appropriate security measures, such as installing and activating a Virtual Private Network (VPN) or other encryption mechanism, a personal firewall, and anti-virus software.

*Service Levels*

The Wi-Fi initiative was subsidized by the Singapore government initially, and offered free wireless access of up to 512 Kbps. This has progressively increased over the years to 2 Mbps. Faster transfer speeds and connection options with higher-quality service are now reserved for those with paid subscriptions.

## Sensing Technology

Singapore's Nationwide Broadband Network provides a robust foundation for the development of the Smart Nation Platform (SNP), which is currently being piloted in the Jurong Lake District. In this district, IDA is piloting an "aggregation-gateway box" (AG box), which extends power and connectivity to non-traditional locations such as street lamps and traffic lights. Sensors deployed near the AG box can then take advantage of high speed back-end connectivity.

The IDA sees similar sensor infrastructure technology in the home as eventually expanding into energy-saving solutions or home health monitoring for chonic care patients with diabetes or heart disease.

This effort comes out of a need to create a shareable infrastructure that can be accessed by government in the public domain. AG boxes, therefore, are taking fiber – traditionally linked only to homes and businesses – into the street. The public infrastructure could be a traffic light intersection or a bus stop. The AG box brings the fiber to a point nearby, and then sensor gateways can be installed that relay their data back to the AG box and on to the main system. This makes it easy for different agencies to place their sensors nearby – whether they be cameras or weather sensors – without having to wrestle with multiple connection points. This common infrastructure will be a crucial step in helping to generate additional applications and create a data-driven anticipatory approach to government services.

The IDA sees similar sensor infrastructure technology in the home as eventually expanding into energy-saving solutions or home health monitoring for chronic care patients with diabetes or heart disease.

Businesses will also benefit from the growing opportunities for sensor technology to help optimize supply chains. This could make a difference for supply trucks, which sometimes sit for hours waiting to unload their goods at a busy mall. IoT technology would enable better information flow and subsequent resource allocation for truck movements and other parts of the logistics chain, ensuring better just-in-time planning – from shippers to freight forwarders to delivery. The same concept can apply to many elements in the public and private sectors.

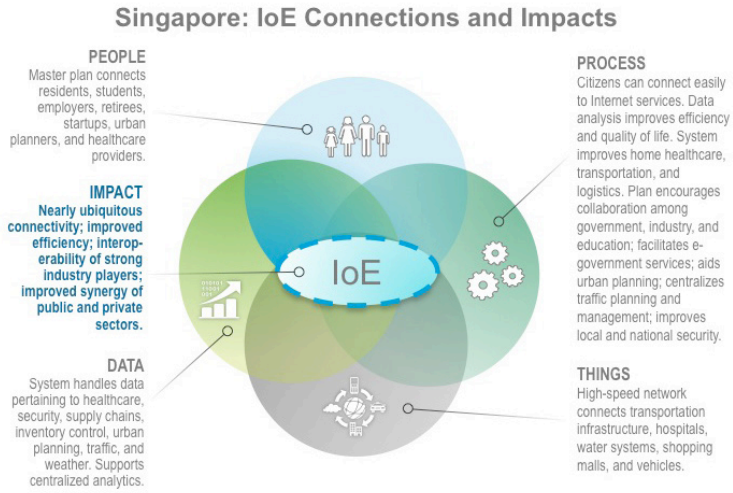
## IMM2025

Singapore's Ministry of Communication and Information is spearheading development of the country's next information and media master plan, IMM2025, which includes the vision of making Singapore the world's first Smart Nation. A key component of this plan is the Smart Nation Platform (SNP), which includes a mesh of sensors placed in the public transportation system, the roadway network, and other key locations. The platform will gather and analyze data to improve operations, quality of life, business, and government services throughout the country. National Broadband Network and wireless infrastructure provide an ideal foundation for this emerging sensor technology.

A key component of the 2025 plan is teaming with the private sector to meet objectives. A steering committee of various industry representatives, chaired by a renowned industry figure, provides critical private sector input.

Benefits include ... enhanced efficiency, solution testing and marketing, interoperability of strong industry players, and synergy of the public and private sectors.

**Figure 1.** Singapore: New and Better Connections.




Source: Cisco Consulting Services, 2014

# Impact

Benefits from Singapore's infocomm planning process and the Nationwide Broadband Network and future Smart Nation Platform include enhanced efficiency, solution testing and marketing, interoperability of strong industry players, and synergy of the public and private sectors.

## Connected Citizens

Singapore's widely adopted NBN demonstrates the success of IDA's program. Importantly, the government took measures to ensure its popularity and uptake. First, the government heavily subsidized installation costs and competition among the service providers. With monthly rates starting as low as S$50 (US$40) per month, the cost of broadband connectivity is among the lowest in the world. This low cost has been an important part of building the network's popularity, and has contributed

to growth in the IT industry. The government also allows constituents to select their network provider.

### Public-Private Collaboration and Innovation Test Bed

While the small size of the country may preclude competition in some large market arenas, the nation also considers it to be a strength. Singapore's size makes it an ideal test market for innovation that the global market can tap into. Using Singapore as a test bed enables IDA to prove certain concepts and, potentially, to scale and test solutions with the 600 million consumers in the ASEAN area – all within a four-hour flight from Singapore. This gives startups the right base from which to reach out to the rest of the world – a key area from which Singapore expects its economy will grow.

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The sensor deployment projects in the Jurong Lake District, for example, are watched closely by many parties, both internally and externally, to see if this solution can be replicated in other cities. The work has already attracted international interest from parties looking to build a common infrastructure that can cross several different domains. Whether they focus on sensors, networking, or apps, these players can come together first to collaborate in the Jurong Lake District, and then across the island to show proof-of-concept solutions can be rolled out nationwide later.

Growth in Singapore's IT industry is spurred in large part by the strong communication infrastructure. For example, Amazon and Google have both set up their own data centers in the nation. Additionally, Singapore's gaming and financial industries have grown in large part due to the nation's high-speed connections and communication infrastructure – creating jobs and economic activity.

## Lessons Learned / Next Steps

### Identifying New Technologies for Investment

The IDA studies various sectors – such as healthcare, logistics, energy, and sustainability – to identify technologies in which Singapore should invest. Nonetheless, the choices are often difficult to make. Singapore is currently evaluating how to incorporate technologies such as IoT, communications, cloud, Big Data, cognitive computing, robotics and more.

### Aligning with Leading Standards

Alignment of technological development with internationally recognized standards gives Singapore's master plan an edge. However, it's a continuing challenge to determine the standards to which the country should align. The IDA works closely with industry to identify the standards that will have worldwide demand. Successfully implementing the Smart Nation vision depends on keeping a close eye on emerging standards and deciding which standards will be important in the long run, whether ISO or other sets of standards.

 

## Future Plans

In terms of future plans, effective data analysis is potentially the most transformative aspect of the Smart Nation plan. With a rich data platform enabled by the plan, analytics can play a larger role. IDA has created a special panel of data scientists to examine the issue.

Next steps involve implementing analytics in multiple contexts, such as managing public transportation and urban planning.

Next steps involve implementing analytics in multiple contexts, such as managing public transportation and urban planning. For example, by studying data on how people travel from their homes to public transportation points, IDA can improve transportation planning. Analytics can address key issues such as whether enough buses are running at a given time, as well as making improvements to infrastructure such as covered walkways to bus stops (essential during Singapore's rainy season).

Analytics also enable cities to make small changes to the public transportation system to improve commutes. For instance, Singapore recently implemented a discounted fare for early-morning travelers. Commuter movement, how people pick fares, where they commonly stop, and when, are all different variables that had to be considered, and could only begin to be done with the rise of Big Data and analytics. These in turn help generate policies that can benefit the people.

## More Information

For more information, visit http://www.ida.gov.sg

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# UIDAI Taps IoE Capabilities to Improve Service Delivery and Cut Costs



**EXECUTIVE SUMMARY**

### Objective

- Enable Indian government to confirm identities of recipients of benefits and services
- Allow banks/customers to link ID numbers to accounts to facilitate transactions via biometric identification
- Improve delivery of government and other service benefits to India's neediest residents

### Strategy

- Assign unique 12-digit identification (ID) number – the Aadhaar – to every resident of India. Each Aadhaar is linked to encrypted personal information and biometric data, including fingerprints and iris scans, to avoid duplication

### Solutions

- Aadhaar database maintains the unique information for each individual in an encrypted packet
- Encryption ensures discrete and secure handling of data

### Impact

- Increased safety net for marginalized and indigent populations
- More convenient ID verification process for both individuals and institutions
- Significant cost savings to exchequer – and estimated return on investment of 52.85 percent

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

 

## About the UIDAI Aadhaar Project

The Unique Identification Authority of India (UIDAI) began the Aadhaar project in 2009 with a goal of assigning a unique identification (ID) number to every resident of India. Each 12-digit ID, or Aadhaar, is linked to encrypted personal information and biometric data, including fingerprints and iris scans, to avoid duplication. The ID numbers and attached biometric data will help the Indian government confirm the identities of recipients of benefits and services. The numbers are also being used by banks and by those participants who link the ID number to their bank accounts to facilitate transactions via biometric identification. While still in an early phase, it is anticipated that institutions and vendors around the country will begin to increasingly accept the Aadhaar and biometric identification as a payment mechanism.

"The vision of the UIDAI is to empower the residents with a unique identity that is valid across the country, and to create a digital platform where these identities can be authenticated on an anytime/anywere basis, instantaneously."

Vijay Madan,
Director General and Mission Director,
Unique Identification Authority of India

As director general and mission director of the Unique Identification Authority of India, Vijay Madan oversees the Aadhaar project. Mr. Madan is 33-year veteran of the Indian Administrative Service and has also served as the chief of economic policy in the Air Transport Bureau of the International Civil Aviation Organization (ICAO), a specialized agency of the United Nations.

Since its inception in 2009, UIDAI has issued more than 620 million Aadhaar numbers, although, Mr. Madan noted, "The enrollment numbers, impressive as they may be, have so far covered only a little more than 50 percent of the country's population." Having ramped up the system and currently operating at full capacity, UIDAI hopes to issue the one billionth card sometime in 2015.

## Objectives

The UIDAI program was originally conceived as a way to facilitate delivery of government and other service benefits to the country's neediest residents, many of whom lack a fixed address or verifiable birth document required by prior systems. "[The government] went into it initially as an identity for specific groups who are marginalized, socioeconomically disadvantaged groups," Mr. Madan explained. "That was the vision with which it was started, and the idea was to be able to use these identities for a variety of purposes – most importantly, to catalyze financial inclusion and to act as a tool for efficient and effective delivery of services and benefits. A unique identity is likely to help with that in the sense that it's known exactly who is trying to access the service, at what point, from where. Then it was realized that because of the movement of people, doing it on a partial basis and not the entire country would not solve the problem entirely. The scope was expanded to include all residents."

For Aadhaar to work, it had to address the issues with previous ID systems: geographic restrictions and language barriers. Additionally, previously used cards or certificates were particularly susceptible to fraud. Mr. Madan said that Aadhaar's biometric identifiers are much more difficult to fake and can be compared for duplicates upon enrollment. "The vision of UIDAI is to empower the residents with a unique identity that is valid across the country, and to create a digital platform where these identities can be authenticated on an anytime/anywhere basis, instantaneously," Mr. Madan explained.

 

Mr. Madan indicated that while enrollment in the ID system is voluntary, it is hoped that an understanding of the program's benefits will provide an incentive for participation. Adding to the scale of the project, Mr. Madan indicates the ID program is designed not just for adults, but children as well.

## Strategy

Mr. Madan described the massive effort to reach each member of the population, including walk-in services at government and non-governmental agencies; a census-type, house-to-house enrollment; and an "introducer-based" system that allows a referral from designated introducers, who accompany those residents unable to verify a fixed address. "We work through 70 registrars, and these registrars engage about 200-plus enrollment agencies, and there are about 25,000 to 27,000 operators working the field. The people at each station do about 40 to 50 enrollments per day. So roughly, we have about a million-plus enrollment possibility per day — 1 to 1.2 million."

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UIDAI engages in extensive public outreach and education regarding the ID system, including broadcast, print, and all types of media. "This is a voluntary program, so we ... let people know that we are doing the enrollment in a particular area," Mr. Madan explained. "The initiative of coming and enrolling for that is entirely with the individual residents. There are places where, of course, the demand is very high and we have to make arrangements to ensure that the systems run smoothly and people don't have to wait unnecessarily."

According to Mr. Madan, public education efforts emphasize the benefits and services available for participation; they point out "how [Aadhaar] becomes a tool of convenience for [residents], whether it is in terms of dealing with their financial institutions or dealing with the banks or dealing with any other institution that they may be a part of, and particularly in the financial institutions and most of the regulatory authorities." UIDAI has established a number of working groups and subcommittees to address outreach and education.

Mr. Madan stated that costs in the five years since the project launched have totaled 40 billion INR, or roughly US$670 million. In fiscal year 2013, UIDAI's operational budget was 15 billion INR, or roughly US$250 million.

## Solution

### Aadhaar Registration

Mr. Madan described the Aadhaar database as a simple and secure system that keeps only the unique information for each individual in an encrypted packet, with no associated data, such as access history. "This data — name, age, gender, date of birth, address, photograph, two iris images, and 10 fingerprints — together form one packet for enrollment. In addition, on an optional basis, [the applicant] could also give his mobile number and email ID, and we do encourage that they do so, because it can be easier for them later to be able to get the information from UIDAI regarding when the Aadhaar is generated or for any authentication that is done subsequently."

In addition to supplying existing forms of ID, residents must verify a home address, if possible. Mr. Madan explained that more than 30 documents, such as utility bills, are acceptable as a proof of address. For those with no fixed address, such as nomadic populations or the homeless, the system allows referral-type "introducer-based" verification from 3,700 officially recognized introducers throughout the country. Mr. Madan explained that to date, this type of enrollment represents less than one half of 1 percent of the total.

UIDAI also partners with the Registrar General of India — who also operates the National Population Register, the country's census organization — for house-to-house contact. "They have a slightly different process because they adopt an areawide approach for any locality," Mr. Madan explained. He said that data gathered by these representatives also includes the limited information required for issuance of the Aadhaar card.

Mr. Madan exphasized that protection of the individual's privacy is a top priority built into the system.

## Data Security and Privacy

Mr. Madan emphasized that protection of the individual's privacy is a top priority built into the system. "As soon as this packet is prepared at the enrollment station, it becomes encrypted," he said. "This encrypted package then reaches the Central Identities Data Repository (CIDR), our official back-end facility where all these are processed. Each one of the iris and fingerprint images is matched with those of the previously enrolled people. For example, today each one such would be compared with the 620 million sets of biometric information that we already have, plus the ones that are being processed on that day. If it is found to be unique, then an Aadhaar number is generated for that person."

According to Mr. Madan, each agent is properly trained and certified to conduct enrollments, and agents must enter their credentials with each application packet to create a traceable record. Each packet is subsequently encrypted and inaccessible to the agent throughout the uploading process to the CIDR. "It's a very secure and a technologically high-end kind of a system where the [agent], while he is doing it, has a specific window in which he can do whatever he can do, but he doesn't have visibility to do this sort of thing before or after. Once encryption takes place, it's controlled by us."

The system is self-cleansing, with submissions purged from individual hard drives upon uploading to the CIDR. Because enrollment often occurs in areas without data connectivity, agents sometimes must travel to an area with connectivity to complete the uploading process. "Within a period of 20 days, [the agent] must upload the entire data. After the packet has been received and it has been processed, in a subsequent sync we will control the purging of the data from those specific client machines."

Mr. Madan said that data security policies are in place within the CIDR as well. "The security in terms of holding the information on behalf of the individual is something that the organization obviously takes very seriously, and all effort is made to keep it completely secure and private," Mr. Madan explained. "When we maintain it in the CIDR, it is encrypted, and in any authentication process we do not share the data unless there is a specific consent given by the resident. That also applies only if he

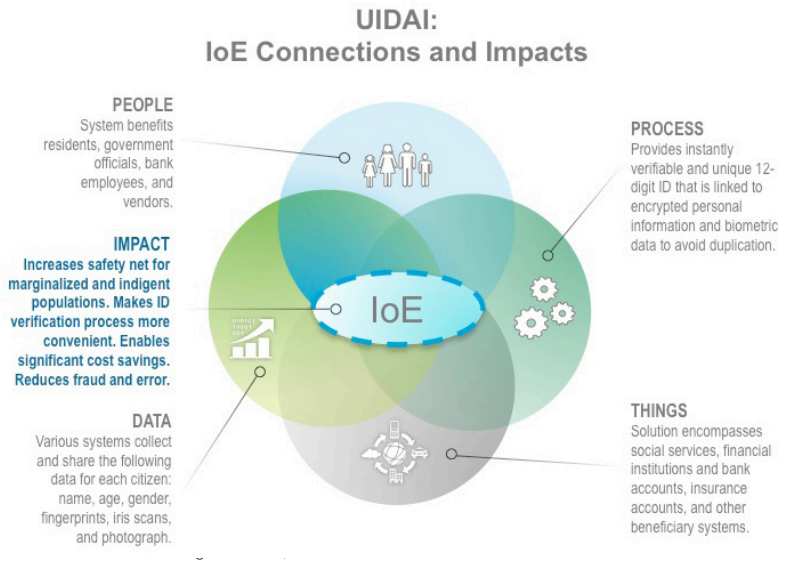
When a bank, for example, wants to verify someone's identity, the person provides his or her number and biometric information, such as a fingerprint or iris scan, and the bank then sends the request to the CIDR. Comparing the data on a 1:1 basis in the CIDR is highly efficient – it provides a brief yes/no response that is then sent back to the institution requesting the identity check.

wants his demographic data and a photograph. The biometric data is not shared at all with any organization."

Mr. Madan further explained the discrete and secure handling of data within the Aadhaar system. When a bank, for example, wants to verify someone's identity, the person provides his or her number and biometric information, such as a fingerprint or iris scan, and the bank then sends the request to the CIDR. Comparing the data on a 1:1 basis in the CIDR is highly efficient – it provides a brief yes/no response that is then sent back to the institution requesting the identity check.

"The identity platform keeps the data collected from the individual to the bare minimum," Mr. Madan stated. "There is no intelligence built into the number, and no profiling data is collected at all. In the process of linkage, while the unique identifier can be used by various programs, the reverse data is never collected by UIDAI. The information about the individual remains with the specific departments alone, and any process of sharing of data from one such program to another department will continue to follow the usual processes of law. Therefore, the data remains segregated and federated."

**Figure 1.** UIDAI: New and Better Connections.




## Impact

### Increased Access to Benefits

Mr. Madan emphasized that the original goal of the project was to provide an increased safety net for marginalized and indigent populations. Because the program was designed for the inclusion of these groups, he is hopeful that Aadhaar will encourage increased participation rates in services offered by both government and private assistance and service programs.

## Convenience

Mr. Madan stressed that a primary goal of the Aadhaar system is to make ID verification more convenient for both individuals and institutions. This is particularly important for industries governed by regulatory authorities, such as financial institutions and insurance companies, which routinely require verifiable customer identification.

Mr. Madan said that Aadhaar includes the technological capacity to be linked to a bank account. More than 67 million Aadhaar number holders have linked their bank accounts to their Aadhaar. The Aadhaar number is accepted by a broadly used system – the Know Your Customer program, or KYC, a tool used by banks, financial institutions, retailers, and other institutions for customer verification. He indicated that the electronic version of this system, the eKYC, is enabled by the Aadhaar program and is gaining in popularity. It is now accepted for participation in transactions with the State Bank of India – the country's largest financial institution – and with institutions regulated by the National Insurance Regulator, the Provident Fund regulator, and various other agencies.

Mr. Madan indicates inclusion in the eKYC system is a significant benefit for Indian residents. "Since customer verification actually takes quite some time if not done through an electronic route, the biggest advantage of the authentication service is that it saves a lot of time. With the Aadhaar, service delivery can take place almost instantaneously. This is important, for example, in situations such as opening new bank accounts – it's a very powerful tool. This is what has made Aadhaar a very potent tool for financial inclusion, and that is one of the major areas in which it is being leveraged."

Mr. Madan believes the Aadhaar's potential to prevent waste and discourage error will also result in a significant cost savings to the exchequer. He referred to a cost benefit analysis of the program by the National Institute of Financial Planning and Policy, which estimated the eventual rate of return on investment for the program as 52.85 percent.

## Cost Savings

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Mr. Madan acknowledged that exact numbers are difficult to estimate, but that all indications for significant savings are promising. "There are different kinds of estimates as to how much leakage and waste exists," he explained. "They could range from 10 percent to 15 percent or even 20 percent in some of the programs, and they may be a little less in the other programs. On average, if it is taken as about 10 percent savings on all schemes run by the federal government for a direct benefit or subsidies, then the whole thing works out to really huge sums. But again, as I said, these are assessments. The assessment of the total contribution of various kinds of services and benefits that Aadhaar could bring on the table could amount to a savings to the exchequer to the extent of about half a percent of the gross domestic product. For a $2 trillion economy, that's a huge sum of money."

 

## Lessons Learned / Next Steps

The biggest challenge of the Aadhaar project, according to Madan, is its ambitious scale. “It is a huge challenge because of the number of people being enrolled on a daily basis, but that’s a continuing kind of thing, and any large program released to the public has to have these kind of things organized.”

There has been negative press, with concerns over privacy and civil rights constituting the majority of complaints, even within the government. A parliamentary committee recently attacked the Aadhaar system, calling it “directionless” and “full of uncertainty.” Critics note the absence of sufficient privacy laws and call for clarification as to how the government will use the information and who will be able to access it.

Mr. Madan advises those seeking to deploy a similar system to build simplicity and security into the program architecture.

However, the system also receives many positive reviews among those closely studying the program. UIDAI received the 2013 DSCI Excellence award for Security in E-Governance. DSCI’s website notes the following:

> *With the inherent complexity involving multiple partners, agencies, registrars, and users, and multiple access modes with an unparalleled number of data records, UIDAI has implemented a holistic approach for identifying and addressing security concerns which includes principles, policies, technology, and architectural aspects.*

Mr. Madan indicated that while educating the public has required huge outreach, significant effort has also been expended in gaining the support of institutions that may benefit from Aadhaar’s services. Mr. Madan explained that those institutions still holding out “are not really looking at it as a benefit from the government.” Outreach efforts seek “to carry the understanding of what is possible, and to leverage this for reengineering processes – followed by any department, service provider, or benefits-granting department dealing efficiently and effectively with their clientele to work out different kinds of applications.”

Mr. Madan advises those seeking to deploy a similar system to build simplicity and security into the program architecture. “The system design has to be such that you are taking the minimum amount of data, and basically use the identity platform only for verification of the identity of the individual and not mix it up with any other process,” he explained.

Mr. Madan indicates that keeping data fresh and updated – a process he refers to as “updation” – is a matter of ongoing study and development. “Any system is only as good as its accuracy, and in this kind of a database, even though we collect only four basic fields – name, age, gender, and address – two of them that are subject to change. People do change their names, particularly after events like marriages, and people routinely change their addresses. Also, their photographs will change after a few years, so there is a constant need for updation of this data.”

 

Mr. Madan continues to work both in the field with residents and to bring institutions onboard. He sees a huge potential for application of the program in many aspects of society. “There are a number of applications in the non-financial sector where identity is required to be proven – for example, with new mobile connections,” he said. “These kinds of things, once they start getting linked to this identity, will be another area that will be on an ongoing basis. It will be ever-expanding and developing, evolving those programs and applications to the best usage or the convenience of the user as well as [contributing to] better efficiency by the service provider.”

Mr. Madan acknowledges Aadhaar as “transformational,” saying, “It will evolve, obviously, with time. What we are looking at now is just the beginning of it, and over a period of years, this has immense capacity for [contributing] a variety of conveniences, in terms of benefits, in terms of what can be done with this.”

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# Internet of Everything and the Public Sector

Jurisdiction Profiles — **EMEAR**

CISCO

# Amsterdam Uses IoE-Driven Capabilities to Cut Energy Usage, Improve Electric Grid's Reliability, and More



**EXECUTIVE SUMMARY**

### Objective

- Drive economic development and global city investment competitiveness, while improving the lives and livelihoods of Amsterdam residents

### Strategy

- Encourage local telecommunications provider and electricity company to develop infrastructure that would support citywide applications
- Develop pilot projects to provide new data and access to help improve service efficiencies and resource reductions
- Build large-scale projects that capitalize on new infrastructure
- Convince city-run and affiliated entities to make procurements with an open-architecture and smart-capability focus

### Solutions

- Initiatives include smart energy grid systems, smart lighting, a smart parking application, smart work centers, public Wi-Fi, and smart building management

### Impact

- 9 to 14 percent savings on energy bills due to apps that provide greater insight into individual energy usage
- Sensors on electric grid have improved the network's reliability, minimizing outages and downtime

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

 

## About the Amsterdam Smart City Initiative

The Amsterdam Smart City Initiative is a citywide effort to develop capabilities and information flows that enhance city operations and quality of life. The initiative currently includes 47 separate projects that contribute to these objectives by providing increased data access, data transparency, data monitoring, and distributed computing. The Internet of Everything concept forms a core element of the initiative, providing increased access, monitoring, and control capabilities through open-architecture computer and network platforms, and by engaging disparate elements of the city to provide for common improvements.

Specific initiatives undertaken within Amsterdam include smart energy grid systems, smart lighting, a smart parking application, smart work centers, public Wi-Fi, smart building management, and more. Many of these projects have been developed as pilot projects in certain parts of the city, with the anticipation that successful projects will be deployed broadly. Projects include Nieuw-West Smart Grid, a smart electric grid project in the Nieuw-West district that includes the addition of sensors and smart monitoring technology on the district's electricity grid; and Flexible Street Lighting, which involves placement of cameras, Wi-Fi routers, and environmental monitors on streetlights on Hoekenrodeplein.

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In March 2014, Ger Baron took up the newly created role of chief technology officer for the City of Amsterdam. The job was created to help coordinate citywide ICT efforts and the overall Amsterdam Smart City initiative. In this role, he oversees Amsterdam Smart City efforts and development of a strategic approach to utilizing technology to improve the lives of Amsterdam residents. Previously he served as cluster manager for ICT and e-Science at the Amsterdam Economic Board (AEB), a nonprofit organization focused on creating public-private partnerships. In that capacity, Mr. Baron's key initiatives focused on innovation, and he played a crucial role in developing Amsterdam's Smart City initiative from the beginning.

Prior to his current role, Mr. Baron worked with one of the local political parties in Amsterdam and prior to that he worked as an IT consultant with Accenture. He has a university degree in Literary Criticism and he also worked in computing during his undergraduate study.

Annelies van der Stoep works with the Amsterdam Economic Board and is currently serving as area manager for the Nieuw West Living Lab and as local coordinator for the City-zen program under the Amsterdam Smart City initiative. She has a background in urban planning, real estate development, and sustainability, and undergraduate and graduate degrees in architecture.

## Objectives

Amsterdam's Smart City initiative started in 2007 as the city considered proposals by tech companies on how city government could improve overall city operations utilizing Internet of Things (IoT) technologies. Concurrently, city officials managing both the city's IT infrastructure and the electricity grid were contemplating upgrades to their infrastructure. Recognizing that implementing citywide applications was more complicated politically than just adopting a new technology, the city decided

 

to focus efforts on building open architecture platforms that could be used for future IoT projects.

Economic development and global city investment competitiveness have been two primary motivators of Amsterdam's Smart City initiative. The third key driver has been improving the lives and livelihoods of Amsterdam residents.

## Strategy

The Amsterdam Economic Board (AEB), a public-private partnership organization that focuses on economic development and improved quality of life for Amsterdam residents, has been the primary champion and driver of smart tech initiatives throughout the city.

"We saw two developments: the city telco had an ambition to speed up its broadband network, and the local (electric) grid operator wanted more energy grids," Mr. Baron explained. "Basically, we said to them, 'You are investing a billion dollars in new infrastructure, and it would make sense to also think about the application of the infrastructure and who is going to use it and when.' In this way, we decided to take more of a 'city as a platform' approach." With this discussion, Mr. Baron and the AEB members encouraged both the local telecommunications provider and the electricity company to develop infrastructure that would support citywide applications.

"We don't believe that people want to live in a 'Smart City' per se. We do believe that people want good healthcare, good education, good traffic flow, to live in an efficient city, and so on. So we don't have campaigns about being a 'Smart City.'"

Ger Baron,
Chief Technology Officer,
City of Amsterdam

These two infrastructure investments formed the basis to Amsterdam's Smart City initiative. The projects took approximately two to three years to implement, from 2008-2010.

Once the architecture of both the city's telecommunications network and the electric grid had been opened up, the city started developing pilot projects to provide new data and access to help improve service efficiencies and resource reductions. Because these network upgrades involved the installation of IP-based hardware, they enabled the addition of new technological layers that could interoperate on the network backbone.

Since that time, the city has started to build large-scale projects that capitalize on the new infrastructure. One of the key projects has been a smart streetlighting project that includes cameras, environmental sensors, Wi-Fi connections, and other technology in the light posts. As the project is launched, the city is testing various models of access and control, to include allowing business owners and residents to view camera information and control lighting levels in their vicinity.

According to Mr. Baron, the key in public messaging is not to focus on "smart cities," or becoming a smart jurisdiction, but rather to focus on what the implications are for improving one's quality of life. "What we want to do is to talk about people living in the city," he said. "We don't believe that people want to live in a 'Smart City' per se. We do believe that people want good healthcare, good education, good traffic flow, to live in an efficient city, and so on. So we don't have campaigns about being a 'Smart City.'"

 

With regard to engaging the public sector and the business community, Mr. Baron indicated his efforts have focused on getting people to think about solutions to problems, and then to use technology as the facilitator of the solutions. In many cases, much effort has been required to get technology on the agenda. Since that foundation was established, it has been integrated into processes in ways that keep innovative thought and technology within the planning process.

Ms. van der Stoep indicated that data privacy is a significant concern in the Netherlands, and that this is affecting how the city goes about collecting and distributing data. In the case of smart electric meters, Ms. van der Stoep indicated that the city and the electric utility are both prohibited from publishing individual household-level data, and that all data that is published must be anonymized to ensure it cannot be traced to a particular resident or household.

According to Mr. Baron, most of the pilot projects were privately funded, with some government support in terms of facilitation. These projects laid the groundwork and helped establish the business case for future, larger-scale initiatives.

In the current second wave of initiatives, much of the work is based on convincing city-run and affiliated entities — including schools, healthcare institutes, grid operators, energy companies, housing agencies, and so on — to make procurements with an open-architecture and smart-capability focus. According to Mr. Baron, this is the key to ensure projectes are scalable to meet the needs of a much larger population.

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The AEB, which oversees many of the city's IT initiatives, has played the lead coordination and motivation role in establishing IT initiatives throughout the city. Recognizing that there was no other entity to provide such coordination, the Board asked both the city and the local infrastructure operators (telco, electricity) to provide some funding. The entities agreed and now, while the infrastructure operators manage the infrastructure, they rely on the Board to coordinate open innovation projects. In this regard, the AEB's ICT objectives include bringing partners together and sharing insights and knowledge. The ICT team is funded by the telecom company, the electric company, and the city. It has a core staff of 12, and receives additional staff from partners when projects dictate.

According to Mr. Baron, both the telecommunications infrastructure and electricity company investments that initially started the Smart City initiative were joint venture projects that involved both the city and the respective infrastructure management companies. The telecommunications company and electricity company are partly city government-owned as well.

## Solution

From the telecom and electricity infrastructure foundation, the AEB reached out to organizations throughout the city to develop pilot projects that utilized the new infrastructure to improve efficiencies and operations. The city attempted 25 pilots initially with healthcare organizations, schools, energy companies, and other similar

 

organizations that may not have been thinking about IT at the time. "We wanted to do it as a pilot and put it on their agenda," Mr. Baron explained. "So for the first two years, until the end of 2011, what we did was basically a bunch of pilots to practice collaboration and implementation of smart solutions. We put together over 100 partners in the first three years, just thinking of smart solutions and concepts."

Out of those initial partnerships and pilot projects have grown a number of other projects; 47 are running currently. These include smart building projects, smart work collaboration centers, a smart parking application, smart traffic management, and public Wi-Fi, to name a few. Other key projects include an open-data initiative that has spurred development of grassroots data analysis organizations and companies, and promotion of smart building technologies in public sector office buildings.

"Nowadays we look less at things like technical feasibility, because we already have the platform and we can provide people to come up with new solutions. Now we look at things such as scalability, and the business case for new projects. We believe that we are out of the testing stage, and that first period was literally just to put things on the agenda of the organizations and to practice collaboration. Now we are in the phase where we are looking at scalability, so it is a bit of a different scope of the things we do."

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Chief Technology Officer,
City of Amsterdam

One large-scale project includes smart electric grid installation by the electric grid provider Liander. In the Nieuw West District, a grid that encompasses approximately 10,000 residences has been upgraded to include computers and sensors placed throughout the grid to monitor activity, current, voltage, and maintenance requirements. This has reduced power outages and better enabled the grid to accept energy back from consumers who install electric generation technologies such as solar panels.

The city has also been active in piloting smart lighting technology in various areas, and is about to go live with another streetlighting system that incorporates cameras, sensors, and Wi-Fi technology on Hoekenrodeplein. Data will be used to monitor public safety, environmental conditions, and lighting conditions. The system will also provide public Wi-Fi.

The AEB continues to fill a primary role of bringing partners together to design and implement additional projects. Mr. Baron leads this responsibility for the AEB, a process that he characterizes as an ongoing brainstorm session. "What we do is make a little funnel and have criterion for projects: they should improve the quality of life, should be technologically feasible, and they should be something innovative and new. A fourth [criterion] we have since added is that they should also be resource-efficient, meaning energy-efficient and contributing to $CO_2$ reductions."

As the initial pilot projects have matured, Mr. Baron indicates that additional criteria are also being applied, due partly to public and press influence. "Nowadays," Mr. Baron said, "we look less at things like technical feasibility, because we already have the platform and we can provide people to come up with new solutions. Now we look at things such as scalability, and the business case for new projects. We believe that we are out of the testing stage, and that first period was literally just to put things on the agenda of the organizations and to practice collaboration. Now we are in the phase where we are looking at scalability, so it is a bit of a different scope of the things we do."

According to Mr. Baron, the system utilizes the Wi-Fi network to collect data from the sensors and cameras located on the streetlights. Ten percent of the network bandwidth is dedicated to this internal use, while the remaining 90 percent is used to provide public Wi-Fi access. The project has involved a consortium of private technology suppliers, as well as a handful of related small and medium-sized local enterprises.

 

Mr. Baron described the city's parking application as highly algorithm- and predictive modeling-based. Rather than placing sensors in each parking spot, the system keeps track of how many have paid and for which time periods. Based on this information, it indicates the availability of parking in areas throughout the city. "What we see right now is that it is not about installing as many sensors as possible, but rather about creating the right algorithm to do the proper analytics." Residents can access parking information and pay parking fees via a smartphone app.

In the district of Nieuw West, the local electric grid operator capitalized on a project to upgrade the grid by installing computers and sensors throughout the grid network. "In the Nieuw West area, this was [an electric] network that needed to be updated," Ms. van der Stoep explained. "So facing those conditions, they decided to add sensoring capability to the electricity grid and improve the grid's ability to manage both the upload and download of electricity. This is in the main infrastructure now, and we are starting a new EU Summit project to see what effect, for example, electric vehicles will have on the stability of the grid." The sensors and control system also allow for remote management of the grid, something that has eased operations at the energy company.

"What we see right now is that it is not about installing as many sensors as possible, but rather about creating the right algorithm to do the proper analytics."

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The city has also begun a project to make city data more readily available, including real-time data such as public transport information, traffic information, and employment flows. The city is starting to use this information to predict future traffic flow, city usage, employment levels, and so on. This has been made possible, not via a large-scale integration, but rather by amalgamating large amounts of data provided by sensors placed throughout the city. The city is using real-time dashboards to collect and display this data in easily readable formats. This information is also shared publicly to allow private individuals to develop applications.

Amsterdam is dealing with questions about who controls or has access to new data and resources. For instance, a newly deployed streetlighting system could allow building owners to access camera information and control streetlighting levels.

**Figure 1.** Amsterdam: New and Better Connections.


Source: Cisco Consulting Services, 2014

 

## Impact

According to Mr. Baron, one of the key ideas initially proposed with the Smart City Initiative was to create insight into city operations. "When we started, we realized that the most important thing about a Smart City was creating insight, giving people insight into the things that are happening in the city. Meaning, when you talk about energy, give people insight into the use of energy. So we started to work with a few companies in the energy grid space and developed energy apps. Remarkably, by giving people insight into their energy bills on a real-time basis, they are saving 9 to 14 percent on the residential side."

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Ms. van der Stoep indicated there have been other benefits for the electric companies as well. Speaking of the Nieuw West smart electric grid system, she indicated that sensors placed on the grid have made improvements in the reliability of the network. Because they are better equipped to monitor grid conditions, grid operators have been able to take necessary steps to minimize outages and grid downtime.

Outside of the electric grid space, Mr. Baron indicated there are other benefits as well – although sometimes there are winners and losers when it comes to results. For instance, due to mobility initiatives, usage of office space has decreased in the past three years, despite a 7 percent increase in employment. While this has had a positive impact on traffic levels and energy usage, it has negatively impacted owners of office buildings and associated businesses.

More difficult to quantify has been the generation of new businesses spurred by the Smart City Initiative. Mr. Baron indicated that more than 40 grassroots initiatives have developed in the energy space alone, such as solar and wind energy projects and electric vehicle sharing.

## Lessons Learned / Next Steps

According to Mr. Baron, coordinating projects across multiple government agencies is not easy. Initially, some of the technology partners believed that all they needed to do was present the mayor with a proposal and convince him that it was worth doing. They did not understand that the city of Amsterdam does not work that way. Different offices have different equities and different interests that need to be addressed. "You're talking about infrastructures that have a write-off period of 20 years, departments that have specialists and all types of interesting KPIs (key performance indicators)," Mr. Baron explained. "Politics means that some things are top of mind, and it is not always about numbers." For example, Mr. Baron indicated that a traffic accident involving smart-traffic applications can, in the political world, set back an initiative five years, even if it makes economic sense. This challenge is partly why the city of Amsterdam has decided to create a chief technology officer position, which Mr. Baron assumed in March 2014.

"There are quite a few processes that are pretty specific for cities," Mr. Baron explained. "There is not a company in the world that has ever managed the [city's complex] planning process from A to B, including the political aspects, the people aspects, the legal aspects. You have rules and regulations you have to comply with,

 

including the subcontracting of different companies in the planning process. The real assets we are now sharing are not only the knowledge the city has of its own processes, but also the specific products and services the city can offer."

Cybersecurity is another challenge with which city officials are just beginning to grapple. According to Mr. Baron, it is not something that politicians have normally considered, although as the architecture of the city's infrastructure has become increasingly open, it is an issue that will have to be addressed.

"Having so much data on your city, everybody talks about privacy," Mr. Baron said. "But I think by connecting things, people get access to more information, and I think the cities that have the most apps and applications will be the most competitive cities in the world. So there is no way back in opening up all this infrastructure."

"Having so much data on your city, everybody talks about privacy. But I think by connecting things, people get access to more information, and I think the cities that have the most apps and applications will be the most competitive cities in the world."

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According to Mr. Baron, the city is also grappling with questions of tax revenue and collecting taxes on Internet transactions and grassroots businesses that operate across governmental borders. Generally speaking, the city is still trying to adjust its operational processes to the new business environment.

Mr. Baron indicated that there have been three critical lessons learned in Amsterdam's process. First is that technology changes so quickly that officials should not think too much about the technology. The focus should be on the challenges and the solutions needed. The technology will then follow.

The second lesson is that an open architecture is essential. According to Mr. Baron, everything in Amsterdam is open, and the city has made a specific effort to avoid proprietary software. "We want to be open in the things that we do – open software, open infrastructures, and open knowledge."

The third lesson is that there are winners and losers in this new business model. So you need the ability to address failure cases in addition to straightforward business cases, and you must organize new types of collaborations. According to Mr. Baron, it is not a one-company game anymore. You need nearly 100 companies for certain solutions, and five or six for many of them. It is a bigger playing field, with complex effect on residents and businesses, and that needs to be addressed. You need mechanisms and organizations to accomplish this.

The city of Amsterdam put out a tender in 2012 to solicit entities interested in starting a new technology institute focused on Smart City applications. A consortium that includes two Dutch universities, MIT, and a number of private companies was awarded the contract to develop the institute, a project in which the city is also intimately involved by providing data and platforms for research. The city is also providing $50 million to the project.

"I think we are now at a moment that the organizational change is going to happen," Mr. Baron stated. "We've been placing [IT] on the agenda, and now is when things are really going to change, and at a speed that I think will be mind boggling. Think about healthcare and health at home, energy, real-time traffic data – all of these things are more or less there. And I think within the next years, we will really commoditize this information."

 

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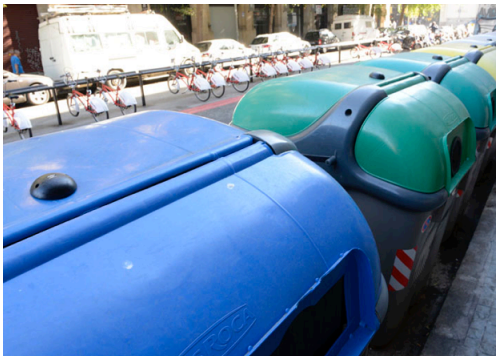
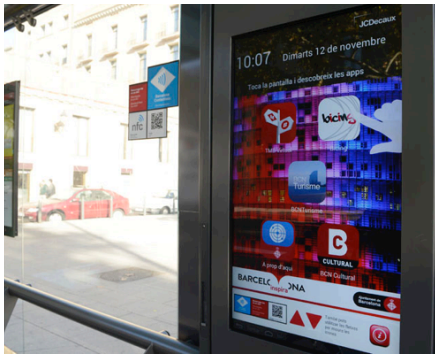
# IoE-Driven *Smart City Barcelona* Initiative Cuts Water Bills, Boosts Parking Revenues, Creates Jobs & More






BCN SMART CITY

**EXECUTIVE SUMMARY**

### Objective

- Improve citizens' quality of life and stimulate new Smart City economy

### Strategy

- Use new ICT technologies cross-directionally to transform the city

### Solution

- Citywide sensors capture vital information for smart water, smart lighting, and smart energy management projects

### Impact

- $58 million annual savings using smart water technology
- $50 million annual increase in parking-fee revenues due to use of smart parking technology
- 47,000 new jobs created as a result of Smart City efforts

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Smart City Barcelona

Smart City Barcelona seeks to efficiently provide city services at multiple levels to all citizens by harnessing information and communications technology (ICT) through development and implementation of the Barcelona Smart City Model. The model identifies 12 areas under which Smart City projects are initiated: environmental, ICT, mobility, water, energy, matter (waste), nature, built domain, public space, open government, information flows, and services. Currently, the city has 22 major programs and 83 separate projects that fit into one or more of these 12 areas. Some of these projects include smart lighting, smart parking, smart water management, and smart waste management.

Barcelona currently has more than 500 kilometers of fiber-optic network, development of which began more than 30 years ago when the city networked two municipal buildings with optical fiber. It was upon this initial network that current Smart City efforts were established. The Smart City project received a massive infusion of attention and focus when the current mayor was elected nearly three years ago. Since that time, the city has put extensive effort into developing a coordinated strategy and approach toward its Smart City efforts.

The [Barcelona Smart City] model identifies 12 areas under which Smart City projects are initiated: environmental, ICT, mobility, water, energy, matter (waste), nature, built domain, public space, open government, information flows, and services.

In 2012, the city government structured its Smart City projects under the umbrella of "Smart City Barcelona." In addition to implementing smart technologies, the city has also utilized these connectivity projects to deliver coordinated services across departments. This has helped to eliminate departmental silos and improve the resident experience in Barcelona. IMI, the Barcelona Municipal Institute of Information Technology, played a key role in this initial organizational formation, which emphasized involvement of the government, residents, and the business community in developing and shaping the city's technological initiatives.

Barcelona is currently using an open tender procurement process to identify a developer to build what the city calls its City OS. This operating system will sit atop the city's established network of sensor technology to collate and analyze data that is collected across the network. City officials envision this OS as an open platform working across the various specific smart technology projects operating in the city. The city sees this platform as the key to unlocking IoE benefits associated with data analytics and predictive modeling.

Ms. Julia Lopez is coordinator of Smart City strategy for the city of Barcelona and coordinator of the ICT International Office for Urban Habitat of Barcelona. She is responsible for overseeing Smart City initiatives and coordinating technology initiatives across city departments. She also is charged with envisioning the city a generation from now, and with helping align current strategies to achieve that vision. The Smart City team also includes Manel Sanroma and Josep Ramon Ferrer.

Separately, Ms. Lopez also manages development and promotion of the city's ICT strategy among other international cities and groups. This involves both formal and informal cooperation with other municipalities and government entities, as well as promoting Barcelona's Smart City efforts globally. A trained telecommunications engineer, Ms. Lopez has worked for the city for seven years, including two and a half years as coordinator of Smart City strategy. She was appointed coordinator of the ICT International Office in January 2014.

## Objectives

According to Ms. Lopez, the seed for Barcelona's Smart City program began more than 30 years ago when the city first installed fiber-optic lines to connect two municipal buildings. Since that time, the city has continued to develop its fiber-optic network.

In 2011, the current mayor made integration of city technology a key component of his election platform. After taking office, his administration immediately began implementing a comprehensive Barcelona Smart City program. The first overarching goal of was to improve efficiency of city services and to address sustainability and environmental concerns. According to Ms. Lopez, the mayor wanted "to transform the lives of our citizens … [and] the companies who are part of the city."

The Barcelona Smart City program aims to provide city services at multiple levels to all citizens based on the use of Internet and telecommunications technology.

"We are not really putting focus on a concrete area, but going little steps forward and thinking about how technology can be used to transform the lives of our citizens. When I am referring to citizens, I am referring not only to those citizens like me who live in the city, but also to companies who are part of the city. As our mayor always says, we have a social dream, which is to transform the city in a generation's time through technology. We think this is the only way to create a sustainable model of living."

Julia Lopez,
Coordinator of Smart City Strategy,
City of Barcelona

## Strategy

Underlying Barcelona's approach to its Smart City efforts is the idea that the city functions as a "network of networks." Ms. Lopez indicated that an initial part of the city's strategy development was to consider how it could connect the different city-affiliated "networks" — for example, transportation, energy, and technology. From this, a blueprint was established.

Barcelona's mayor has placed significant emphasis on development of Barcelona's Smart City capabilities. One key step has been the establishment of a Smart City Strategy team within the mayor's office. This office is charged with promoting and coordinating Smart City application development throughout the city organization. This senior-level political support has been crucial to Barcelona's ability to develop is Smart City projects.

Increased government transparency has also been a critical component of the Barcelona Smart City strategy, helping city officials communicate and explain why they are developing new smart applications or publicly sensitive solutions, such as newly reconfigured bus routes. This has been helpful in gaining public support for projects, especially in a difficult fiscal environment.

Ms. Lopez believes that the political desire to examine and create a Smart City is vital to successfully implementing these projects. "This would not have been possible if we did not have top-down political vision," she says. "This has been very important. You can start thinking bottom-up, but the big, final push was at the political level. If you don't have political willingness, it is impossible."

When initially rolling out the project, Ms. Lopez indicated that coordinating across the various city departments was a challenge. The key to success in this case became the top-level support from the mayor, which helped to cut through various layers of city bureaucracy and bring departments together.

The city took a tailored approach to encourage different public sector areas and departments to participate in the project. This included consolidating and streamlining projects already in motion before the blueprint for the Smart City project was developed. Ms. Lopez said, "It is difficult in a city like Barcelona, with 1.6 million residents and more than 16,000 [public] workers, to go through different departments that historically have worked quite isolatedly and tell them they have to start collaborating. On one hand, we had new projects thanks to the work that we did mapping some initiatives and finding synergies. On the other hand, we also took pre-existing projects and initiatives and tried to find synergies between them. Ultimately, we transformed from five different networks – each managed by different departments – to managing a single network via the city's IT department."

"We recognize that all of these developments cannot be done only by the city. You have to follow a strong and well-thought-out public/private partnership approach in which you have to account for both large and small private sector participants."

Julia Lopez,
Coordinator of Smart City Strategy,
City of Barcelona

The city also had to adapt to dealing with large multinational companies that may not be accustomed to working at the municipal level. According to Ms. Lopez, partnering with key technology firms has been a crucial part of developing Barcelona's Smart City capabilities. "We recognize that all these developments cannot be done only by the city," she said. "You have to follow a strong and well-thought-out public/private partnership approach in which you have to account for both large and small private sector participants."

Ms. Lopez indicated that the city contracting with the tech firms to ensure that the system architecture remains open and not linked to proprietary technology. On many occasions, this has led to funding for new, sustainable business models. For instance, while this has meant companies cannot rely just on added revenue coming from future software upgrades, Ms. Lopez indicated that companies have come onboard more readily because they now have a successful platform they can market and sell in other municipalities.

Ms. Lopez indicated that the city uses its data to engage city residents in the Smart City process. The city's open government platform brings citizens and public servants into closer contact and provides transparency into government operations. Additionally, the Open Data project allows citizens to access data collected by the city. This allows residents to see what is being accomplished through the Smart City process. Ms. Lopez says the hope is that by training and engaging city residents, the city can assuage questions or concerns about the program during the initial phases of implementation.

"We have to be very open and explain things," Ms. Lopez said of communicating the projects and initiatives to the public. "I'm sure you have heard that Spain is in an economic crisis. We have to go to our citizens to explain very well why we do what we do.

"It is a change that affects the city and citizens in the midterm and long term, but in the short term, our citizens have other worries, so it is something we have to take care of," Ms. Lopez added. "We have to explain it is something that is for the good of the citizens in the future."

## Solution

The city looked at ways to use the Smart City initiative to create a single Internet and telecommunications architecture for the city. The existing fiber-optic network provides the backbone for the various smart technology projects. This infrastructure backbone is operated by the local telecommunications firm, a public-private contract that was awarded via tender. "The fiber-optic network was one of our main projects, and we call it transversal because it is the layer on top of which we develop all of the Smart City projects in the city," said Ms. Lopez.

Barcelona is structuring the various projects in three technological layers. The first layer consists of sensors that have been deployed throughout the city in conjunction with the various projects. Currently, this platform is being used for smart water, smart lighting, and smart energy management projects, as well as others. The city plans to expand use of the sensor network in coming years. The city's sensor platform is called Sentilo (www.sentilo.io) and was developed specifically to aid the city in bringing all of its sensor data together. Barcelona has since made the Sentilo platform fully open source and provided it for download on Github so other cities or organizations can use it for similar purposes.

"If we can pull this off, I assure you, it will be a revolution."

Julia Lopez,
Coordinator of Smart City Strategy,
City of Barcelona

The intermediate, or second, layer of the technology architecture is the City OS, a platform created by the Barcelona city government to aggregate and analyze all data gathered from various city applications. This includes modeling for data analytics and predictive analytics applications. According to Ms. Lopez, this initiative is still in development, and there is a tender out for bid.

The third layer of the "urban platform" is the sharing of data and analytics provided by the City OS with both clients within the city government and external data users. This will enable both public and private sector development of applications to improve city services and operations, along with helping to produce a better educated administration and citizenry. "If we can pull this off, I assure you it will be a revolution," Ms. Lopez stated.

The city developed a master plan developed in 2012 that includes projects to remotely control street-level lighting and to transition 50 streets and more than 1,100 lampposts to LED technology. In addition, Barcelona worked with utilities to create a program to achieve greater energy efficiency, deploying more than 19,500 smart meters in the Olympic Villa. The plan also includes implementing remote irrigation control for the city's green spaces, which thus far includes 77 remote-controlled fountains and two networks that provide hot water in 64 buildings.

The city's smart transportation initiative includes deploying orthogonal bus lines and zero-emissions mobility options, which include more than 500 hybrid taxies, 294 public electric vehicles, 262 recharging points, 130 electric motorbikes, and 400 private electric vehicles.

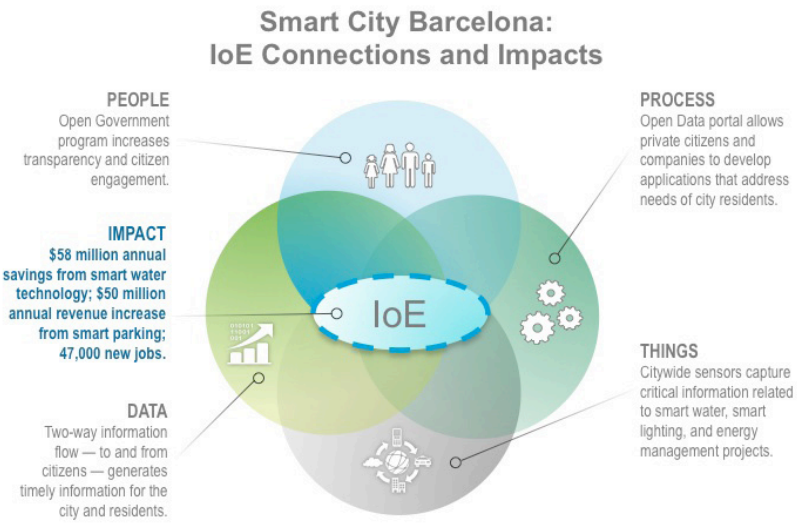
The city also initiated the Open Government program, which aims to bring transparency of the municipal government to citizens. This started with the deployment of 44 "Citizens Attention" kiosks and the launch of an Open Data portal that allows private citizens and companies to develop applications that address needs of city residents.

"The first visionaries of the city were those people in the '80s in the city of Barcelona," Ms. Lopez said. "They decided to try to connect municipal buildings with optical fiber. No one was thinking that this was something that could be useful, but 35 years after, we now have one of the larger fiber-optic networks owned by a city …. We have more than 500 kilometers of cooperating network. Thanks to these visionary people that decided to connect these first two buildings, we now have a powerful network that is giving us the ability to develop and test the smart services in the city."

Barcelona Deputy Mayor Antoni Vives indicated that Barcelona is saving $58 million annually using smart water technology, and that the city has increased parking-fee revenues by $50 million annually utilizing smart parking technology. Vives also stated that Barcelona has created 47,000 new jobs through its Smart City efforts.

**Figure 1.** Barcelona: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

During his presentation at CES in January, Barcelona Deputy Mayor Antoni Vives indicated that Barcelona is saving $58 million annually using smart water technology, and that the city has increased parking-fee revenues by $50 million annually utilizing smart parking technology. Vives also stated that Barcelona has created 47,000 new jobs through its Smart City efforts.

According to Ms. Lopez, Barcelona Smart City has educated city officials on how the city operates and helped increase efficiencies. The pilot programs have allowed project leadership to determine the best course of action for initiatives, such as the Urban Lab pilot on IT-enabled lighting. "Installing new lighting in the city, but also connecting lampposts to our fiber-optic network that can be controlled point-to-point, was a pilot in the Urban Lab in 2009 and 2010. Different technology was tested, and we came to a conclusion about which technology was most suitable for us."

Increased transparency and citizen engagement through the Open Government platform has been another benefit, which has helped citizens realize the importance of supporting the Smart City efforts by making them feel engaged in the process.

Yet another benefit has been the IT industry connections made through Barcelona's pilot programs – with both smaller entities and industry leaders – that will help the city have suitable partners for funding and implementation of the long-term Barcelona Smart City goals.

## Lessons Learned / Next Steps

Going forward, the city anticipates deploying its planned City OS, which city officials anticipate will help the city begin to see significant benefit as data is compared and analyzed, allowing for improved planning and decision making. Additionally, the city anticipates further development of some of the pilot projects currently being tested, as well as greater empowerment of the private sector in application development as additional city data is released.

Ms. Lopez sees the Zero Emissions Mobility initiative as one having particular promise. This initiative involves multiple projects, including electric vehicle recharging ports at the street level and promoting private initiatives to supply electric rental cars, all with the focus of helping Barcelona's development as a technology-efficient, data-driven, environmentally sustainable 21st century city.

Ms. Lopez says that a big takeaway from the implementation of the Barcelona Smart City initiative is to set clear objectives and map out the steps necessary to attain the goals. The involvement of top-down political leadership to ensure that projects have full support is a key factor, as well as having a leadership structure to coordinate the different aspects of the project. "You have to think 'Do you want to be smart? What do you want the city to be as it grows, and how can you use technology to accomplish this?'" she said. By strategizing early on, potential roadblocks can be seen and needed resources identified before challenges arise. "You have to start setting up the projects and, once you have the vision and a good army to help you develop the projects, it is easier," Ms. Lopez explained.

Of the specific projects currently in development, Ms. Lopez sees the Zero Emissions Mobility initiative as one having particular promise. This initiative involves multiple projects, including electric vehicle recharging ports at the street level and promoting private initiatives to supply electric rental cars, all with the focus of helping Barcelona's development as a technology-efficient, data-driven, environmentally sustainable 21st century city.

As it implements the 83 projects across the 12 identified areas, Barcelona is hoping to see dividends in the form of a more efficiently run city with a citizenry engaged with an open government, as well as a technological infrastructure that will attract companies and investment. By aggregating and analyzing the data being collected from all the sensors, Barcelona Smart City hopes to gain a better idea of what needs to be done to become a city of the future.

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# Dubai Harnesses IoE to Make Roads Safer and to Increase Usage of Public Transportation

## EXECUTIVE SUMMARY

### Objectives

- Improve the traveler experience by making Dubai's roads safer and less congested
- Increase usage of public transportation
- Make all city services available 24/7 via handheld devices

### Strategy

- Evaluate each initiative at project inception, as well as throughout implementation

### Solution

- Dubai Smart City Initiative includes plans to implement 100 programs and 1,000 Smart Services by 2015 across all government services, including transportation.
- Initiatives include driverless metro service, uniform ticketing and easy payment for public transport, no-stop toll gates, and smart parking meters

### Impact

- Reduced traffic fatalities from about 20-22 per 100,000 citizens in 2005 to fewer than 4 per 100,000
- Increased percentage of citizens using public transportation – from 6 percent at start of program to 12 percent today
- Improved traveler experience by reducing traffic congestion

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About the Dubai Smart City Initiative

The Dubai Smart City Initiative was established in 2013 by His Highness Sheikh Mohammed with the charter to transform Dubai into one of the world's smartest cities. In an aggressive strategy, the city plans to implement 100 initiatives and 1,000 Smart Services by 2015 across all government services, including transportation. The goal is to automate government services as much as possible, and make transactions — including those involving transportation — conveniently available to the people of Dubai using mobile technology.

Initiatives undertaken by the Roads and Transport Authority (RTA) include driverless metro service, uniform ticketing and easy payment for public transport, no-stop toll gates, and smart parking meters, all of which are currently in operation. Ultimately, all areas of RTA governance — including buses, metros, taxis, marine transportation, parking, roads, and traffic — will be centrally monitored and controlled at the Enterprise Command and Control Centre, currently under development.

Mr. Al Madani describes H.H. Sheikh Mohammed's Dubai Smart City announcement in 2013 as a large-scale plan to incorporate smart technology through all government services, including public transportation. One key goal is to make all city services available 24/7 via handheld devices.

Abdulla Al Madani is chief executive officer of corporate technical support services for the RTA. Mr. Al Madani holds a Bachelor of Science degree in management information systems from the University of Colorado, Denver.

Mr. Al Madani has been extensively involved in IT, including work as the head of operations and networks for Dubai municipality. He has chaired several important government committees, and is the current chair of the IT Higher Committee for Governance. Mr. Al Madani has worked with the RTA in a number of pivotal roles, including IT director and corporate IT director, prior to his current position. Under his management, RTA has won a number of local and regional awards, including the Best e-Government Award and Best e-Service Award in GCC.

He oversees 22 separate Dubai Smart City initiatives, and anticipates making more than 200 government services available via mobile apps. He has overseen development of apps providing taxi services, bus schedules, trip planning, parking payment, and uniform ticketing and payments for public transportation.

## Objectives

Mr. Al Madani describes H.H. Sheikh Mohammed's Dubai Smart City announcement in 2013 as a large-scale plan to incorporate smart technology throughout all government services, including public transportation. One key goal is to make all city services available 24/7 via handheld devices.

"Dubai was facing a huge issue with regards to traffic, the number of accidents, and the unfortunate deaths resulting from these accidents on the roads," said Mr. Al-Madani. "The vision of the Roads and Transport Authority is safe and smooth transport for all."

According to Mr. Al-Madani, in addition to increased safety, RTA initiatives are designed to promote the use of public transportation.

## Strategy

Mr. Al Madani cited eight core strategies by which he and his colleagues judge the effectiveness of each initiative in reaching Dubai Smart City goals:

1) Integrated Dubai

2) Dubai for the People

3) Customer First

4) From Cars to Public Transport

5) Safety and Environmental Sustainability

6) Financial Sustainability

7) Advanced RTA

8) Asset Sustainability

"We have from day one considered technology as an important tool to achieve our vision."

Abdulla Al Madani,
Chief Executive Officer of Corporate Technical Support Services,
RTA

RTA evaluates each smart initiative based on these eight goals. This evaluation is done both at the project inception phase, as well as throughout implementation. This allows RTA to determine success of the project and the degree to which its initial assessments with regard to potential benefits were accurate.

Mr. Al Madani states that safe and smooth travel is the objective in all transportation initiatives. "One of the ways to achieve this is by adopting technologies and innovative approaches," he says. "We have from day one considered technology as an important tool to achieve our vision."

United Arab Emirates government entities fund all Dubai Smart City initiatives. Mr. Al Madani commented that transportation department operations are self-funding given passenger revenues, but that the government typically provides funding for capital investments required on large-scale infrastructure projects.

RTA owns and manages each of the transportation initiatives outlined, as well as the infrastructure associated with the system. In some cases, it has contracted with private firms to provide certain services. Taxis, for instance, are franchised, and the metro is operated by a private operating firm.

## Solution

Key technological initiatives implemented by RTA include the following:

### Uniform Ticketing and NOL Cards

Central to Dubai's public transportation system is the NOL card, an automated payment system that operates as a debit card for public transportation and parking. NOL cards can be purchased at more than 2,000 locations in the city, and can be loaded with transportation credit at metro stations, bus stations, water bus stations, parking meters, and with certified agents, including major supermarkets and some banks. Banks also offer automatic topping of card accounts when they reach a minimum balance. Passengers can also load the card using mPay, Dubai Smart Government's e-payment app.

Mr. Al Madani indicated the NOL card uses tap-and-pay technology for buses, water buses, taxis, the metro, and parking. “The technology behind [the NOL card] is to provide a contactless wallet using the different modes of transport,” he explained. “For the customer, it is just coming to the gate or coming to the check-in or checkout bus device, and just touching the card or showing the card to the sensor.”

Near field communication (NFC) capabilities and GSM technologies also facilitate payments of fares among those with compatible mobile devices. For this payment option, passengers can “smart-swipe” a phone with the NOL app installed in proximity to the payment device in buses, water buses, or the metro to complete payment.

Fares for multi-leg travel are calculated remotely at a data clearing house. “If [the customer] is using multiple modes of transport, like using a bus and then a metro, then the calculation happens in our clearing house, as to how much of this fare should go to the bus operator, how much should go to the metro operator, and so on,” Mr. Al Madani explained. “Once you tap, immediately it gets back into the clearing house.”

Passengers can download a free application, Wojhati, which interfaces with the AVM for schedules and alerts, and for assistance with journey planning.

For the metro, Mr. Al Madani stated that data transfer occurs via fiber-optic cables. For taxis and water taxis, data transfer is facilitated by a GPRS connection. Currently, each bus stores fare data until the bus returns to the station, at which point the data is automatically downloaded via a Wi-Fi connection. RTA anticipates in the future connecting buses via GPRS as well, but currently has not due to the cost of GPRS bandwidth and the large number of bus payment transactions. Buses, however, are connected through GPRS to transmit location data via the Automated Vehicle Management System.

## Automated Vehicle Mangagment System and the Wojhati App

City and water bus schedules, notifications, and some fare calculations are managed through the Automated Vehicle Management System (AVM). Passengers can download a free application, Wojhati, which interfaces with the AVM for schedules and alerts, and for assistance with journey planning. The AVM system tracks each bus along its journey and transmits that data to displays at bus stops, to the Wojhati app, and to an RTA command center.

According to Mr. Al Madani, the Automated Vehicle Management System integrates with four different systems: the NOL ticketing system, the real-time bus location system, the Wojhati journey planner app, and the automated passenger accounts. The AVM system provides the exact location of the buses and the routes, along with feedback if there are delays – information that can be sent to passengers via the Wojhati App or SMS if they have an established passenger account.

## Driverless Metro

Dubai is one of the first cities in the world to implement a fully automated, driverless metro rail system. Two lines transport passengers along 75 kilometers of rail, the world’s longest driverless track. The system sends and receives data via its own fiber-optic cabling.

The Dubai driverless metro is a closed system that is managed from a central command center staffed and operated by RTA. Onboard train communications also include video surveillance, and each car is Wi-Fi-enabled for passengers.

## Smart Parking

Mr. Al Madani indicated that Dubai has installed solar-powered smart parking meters throughout the city. Parking can be paid using the NOL card or mPark, a free parking app that allows payment via SMS. The application also offers text notifications when parking time is about to expire, allowing motorists to refill the meter remotely. Meter attendants also receive wireless communication from meters, and are notified when meters are full or out of order.

Mr. Al Madani indicated that Dubai has installed solar-powered smart parking meters throughout the city. Parking can be paid using the NOL card or mPark, a free parking app that allows payment via SMS. The application also offers text notifications when parking time is about to expire, allowing motorists to refill the meter remotely.

The meters use GPRS technology for data transfer, including NOL and mPark payments, and notifications to meter attendants. “Parking inspectors have handheld devices and know automatically if a car has paid the fee or not,” says Mr. Al-Madani. “It is well-connected through GPRS, and it is real time.” The system also alerts meter attendants when a particular meter’s cash box is full, or if something is not working correctly, simplifying maintenance of the system.

Mr. Al Madani indicates that data security in all initiatives is paramount. Developers are ISO 27001 certified, and Mr. Al Madani and his colleagues have taken additional measures to maintain secure data. “Security is an important thing for us, like any other organization,” he said. “We are using the best possible standards.”

“The most important thing when it comes to security is governance,” Mr. Al Madani explained. “In RTA, we have the IT Higher Committee for Governance, which I’m chairing. All the systems, all the technologies, all the strategic decision making regarding the technology has to be presented in this committee, and we look at it from different areas. Lastly, we have a dedicated security team in RTA.”

## Salik Toll System

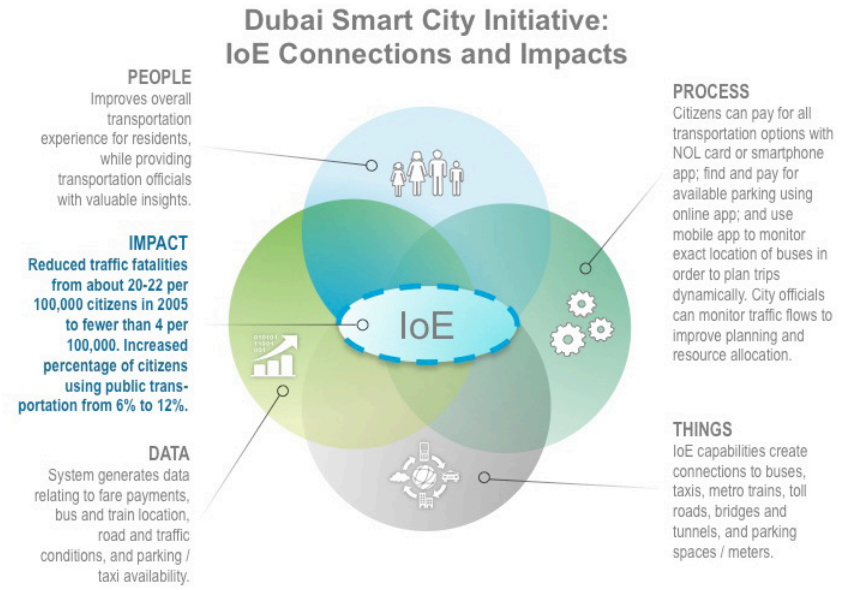
In an effort to reduce traffic congestion, Mr. Al Madani and the RTA implemented Salik, an all-electronic system that allows drivers to pass through toll plazas without stopping. Motorists procure a prepaid card that is affixed to the windshield. The card acts as a passive RFID tag, and allows the driver to pass under the toll gates. An appropriate toll is automatically deducted from the balance on the card at each plaza.

## Taxi Applications

Other applications popular in Dubai are the Water Taxi and Uber Taxi apps, which allow taxis to be ordered via mobile devices. They provide real-time information about the vehicle, journey, and cost, and allow for automatic payment via the NOL system.

Figure 1. Dubai Smart City Initiative: New and Better Connections.




Source: Cisco Consulting Services, 2014

"We have [increased] the most important thing: safety. We have managed to reduce fatality rates in the city from something in the range of 20–22 per 100,000 when we started in 2005 to around fewer than four."

Abdulla Al Madani,
Chief Executive Officer of Corporate Technical Support Services,
RTA

## Impact

According to Mr. Al Madani, the RTA has made significant progress toward its primary goal of increased traveler safety. Since the RTA was established in 2005, traffic fatalities have dropped dramatically. "We have [increased] the most important thing: safety," he said. "We have managed to reduce fatality rates in the city from something in the range of 20–22 per 100,000 when we first started in 2005 to around fewer than four."

Another important goal for RTA initiatives has been encouraging residents to use public transportation, and these efforts are also showing positive results. Says Mr. Al Madani: "One of our goals was moving people from cars to use public transport. When we started eight years ago, the percentage of people using public transport as only 6 percent. Today, we have reached more than 12 percent, and our goal is to reach 20 percent by 2020 and 30 percent by 2030."

Traveler convenience is yet another benefit of Mr. Al Madani's work. The jump in customers using public transport means fewer cars on the road and smoother traffic. Smart parking and automatic toll payments have also simplified the travel experience in Dubai, and the driverless metro system is one of the most advanced in the world. Purchases of NOL cards are robust, and downloads are steady for the NOL app, the Wojhati trip planner, and the taxi apps, further contributing to efficient travel.

"Most of our initiatives are going to move into the hands of the customer, on devices that they hold in their hands. They are all geared toward making Dubai smarter and providing a better quality of life. There are a lot of machine-to-machine services that we have introduced to reduce the involvement of human beings and provide services in the most efficient way to our customers."

Abdulla Al Madani,
Chief Executive Officer of Corporate Technical Support Services,
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## Lessons Learned / Next Steps

Mr. Al Madani feels that one of the most important decisions made during early development was to include customers in the planning stages of each project. "You need to understand and involve the customer as much as possible," he said, "because something that you think is right might be something that the customer really doesn't want."

Mr. Al Madani is planning a central management hub for all transportation services – the Integrated Transportation Information Centre, or ITIC – which he expects to begin operation in 2015. Within two years, he expects to open an even larger facility, the Enterprise Command and Control Center. The Center will centralize monitoring and management of all aspects of public transportation, including buses, metros, taxis, marine transportation, parking, roads, tunnels, bridges, and traffic.

Mr. Al Madani continues to oversee development of mobile technology to facilitate the incorporation of government services into easy-to-use mobile applications per the goals of Dubai Smart City. "We will have around 22 new projects or enhanced projects to move towarda smarter city," said Mr. Al Madani. "Most of our initiatives are going to move into the hands of the customer, on devices that they hold in their hands. They are all geared toward making Dubai smarter and providing a better quality of life. There are a lot of machine-to-machine services that we have introduced to reduce the involvement of human beings and provide services in the most efficient way to our customers."

# Hagihon Uses IoE Capabilties to Save Water, Improve Customer Service, Cut Costs, and Raise Profits



## EXECUTIVE SUMMARY

### Objective

- Reduce water loss while preserving the company's bottom line

### Strategy

- Replace traditional, labor-intensive work model with one that takes advantage of smart technology
- Implement a variety of both high- and low-tech strategies, and cultivate several key technological partnerships, to increase efficiency and profitability

### Solution

- Smart water management and conservation solution that integrates sensor technology and advanced analytics
- Includes SCADA and GIS systems, water-usage analytics, leak-detecting acoustic sensors, ERP system, and mobile phone application

### Impact

- Significant decrease in overall NRW (water loss), and increased profitability
- Improved efficiency, with sensors doing data collection previously conducted manually
- Cost savings by eliminating need for monitoring staff and onsite accommodations
- Improved customer service
- Reduced incidents of theft and carelessness

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases — how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions — federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) — to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About Hagihon

Hagihon, Israel's largest municipal water utility, was established in 1996. The company is leading the way in incorporating a variety of smart devices into the water infrastructure in and around the city of Jerusalem, eliminating the need for manually intensive data-monitoring processes and vastly improving water system management, maintenance, and revenue collection.

Hagihon, which serves the 1 million residents of Jerusalem and two neighboring townships, employs 230 people in-house and an additional 150 people through outsourcing. The utility purchases its water supply from Mekorot, Israel's national water company, and operates and manages distribution via 1,200 kilometers of water grid, roughly 1,000 kilometers of sewers, 450 to 500 kilometers of storm drainage, and 35 kilometers of pressured-treated effluent irrigation pipes (tertiary treated sewage water used for irrigation of city parks).

As business development director for Hagihon, Mr. Yeres is seeking to replace much of the traditional, labor-intensive work model with one leveraging smart technology.

Joshua Yeres, who leads business development for Hagihon, is responsible for creation of the company's business models and implementing management's long-term strategies. He is integrating sensor technology and advanced analytics into the industry, and seeks to develop Hagihon as a leading global player in smart water management and conservation.

Mr. Yeres is an Israel-based economic, financial, and business development consultant. He has worked as a manager for Giza Singer Even Financial Consulting, and as a senior strategic and operational advisor for the government of Israel.

## Objectives

In Israel's semi-arid climate with limited fresh water, Hagihon is seeking new ways to reduce water loss. Mr. Yeres described non-revenue water (NRW, or water loss) as a serious concern in arid areas such as Israel, making water conservation a high priority. He indicated leaks and unmetered water supply are typical sources of NRW, but categorized unpaid water bills and water theft as NRW as well.

Another main priority in water management is preserving the bottom line. This is particularly important in an industry as tightly regulated as water utilities. "There is always an issue of achieving high efficiency," Mr. Yeres said. "This is driven by the fact that the water authority sets the national level of costs and expenses, prices, and procedures for all the water companies in the country. We are given a certain framework of what we can charge, and we are being held responsible to make sure we make the most money out of that."

## Strategy

As business development director for Hagihon, Mr. Yeres is implementing the company strategy of seeking to replace much of the traditional, labor-intensive work model with one leveraging smart technology in order to achieve greater efficiencies.

Hagihon receives revenues from water customers, and pricing structures are set by the Israeli government. Profits are realized through the effective control of

costs, including reductions in NRW and other efficiency gains. Hagihon finances its technological investments with investments "in-kind," accessing governmental or international technology development financing – such as Government of Israel Office of Chief Scientist or European FP7 programs, or in a framework of strategic relationships with technology companies – and then creating a business case to justify the investment.

Hagihon is a regional water & wastewater utility owned by the City of Jerusalem and the townships of Abu-Gosh and Mevaseret Zion. It is regulated by the government of Israel through the Israeli Water & Sewage Authority, which sets standards and pricing. Mekorot, a quasi-governmental agency, manages water supply sources, purification, and the national water transport grid.

All water-monitoring data captured by SCADA and the sensor systems – as well as water composition information such as pH, turbidity, and chlorine levels – is channeled to the company for ongoing, real-time analysis. Results are available to Hagihon employees in easy-to-understand formats for computers and smart devices, providing useful decision-support information to all levels of staff, and allowing easy identification of both normal patterns and anomalies.

Mr. Yeres stated that in the pursuit of lower NRW, "there is no one silver bullet for anything." The company implements a variety of both high- and low-tech strategies, and cultivates several key technological partnerships, to increase efficiency and profitability. Hagihon continues to search for additional innovative technology companies with which to collaborate in the development and implementation of relevant technologies, systems, and methodologies.

## Solution

### SCADA and GIS

Hagihon's service area is divided into a grid of 100 (and growing) district management areas, or DMAs. Each DMA is equipped with a variety of sensing technology, including pump and in-ground sensors. These allow easy tracking of water pressure and flow, and detection of anomalies. A SCADA (supervisory control and data acquisition) system controls the pumps, control valves, pressure reducers, district flow meters, and other components that make up the municipal water network.

Information from the sensor network is fed to a Geographical Information System (GIS)-enabled data management system to provide a geographic, real-time map of the current condition of the water grid. It serves as a visual database of information for each area of the grid. Mr. Yeres explained that information includes details on each water meter, including the name of the property, the party responsible for payment, the number of people in the residence or building, the age of the water infrastructure, and a record of maintenance issues.

### Water-Usage Analytics

The information from the sensors is sent to an analytics software provider, and the solution features a user-friendly web interface to identify system anomalies. All water-monitoring data captured by SCADA and the sensor system – as well as water composition information such as pH, turbidity, and chlorine levels – is channeled to the company for ongoing, real-time analysis. Results are available to Hagihon employees in easy-to-understand formats for computers and smart devices, providing useful decision-support information to all levels of staff, and allowing easy identification of both normal patterns and anomalies. "Everything here

is sent off for us to access from wherever we are on their web-based system," said Mr. Yeres.

Hagihon has developed a strong relationship of technology development and implementation with the analytics provider. Mr. Yeres described this as a crucial alliance, saying the algorithms they have developed allow for quick identification of patterns and irregularities. "[The analytics company] started with statistically analyzing data from the SCADA. They were able to digest it and therefore learn on a day-to-day, hour-to-hour basis what is the normal or accepted behavior in every [district] in a certain day, a certain time. By knowing what is expected, they can easily point out any anomalies. That's the key rule, finding any anomaly," Mr. Yeres said.

"Using mobile GSM technology for communication and GPS time and location fixture, they can [provide] a very good time and location of hidden pipe leaks. Now I finally have a system – besides pressure and flow sensors – that is giving me some sort of touch, hands-on, with what is going on inside my pipes under the ground. This is the first time we have information on our below-ground assets, and we will start using this information for asset and maintenance management."

Joshua Yeres,
Director of Business Development,
Hagihon

According to Mr. Yeres, the strength of the analytics system lies in its ability to highlight anomalies quickly, so that leaks and flow problems can be corrected, even before customer complaints start coming in. The system compares regular water-flow data with a baseline and will automatically alert relevant employees via email and text message if certain discrepancies arise. This has allowed Hagihon to eliminate the need for a technician to watch the network data continuously.

## Leak-Detecting Acoustic Sensors

Fixed acoustic sensoring equipment is another important technology in Hagihon's water conservation. "They have designed an acoustic sensor and added a modern algorithm with cloud-based technology," Mr. Yeres explained. "Using mobile GSM technology for communication and GPS time and location fixture, they can [provide] a very good time and location of hidden pipe leaks. Now I finally have a system – besides pressure and flow sensors – that is giving me some sort of touch, hands-on, with what is going on inside my pipes under the ground. This is the first time we have information on our below-ground assets, and we will start using this information for asset and maintenance management."

Mr. Yeres stated that more than 2,000 sensors are being deployed in Hagihon's 1,200-kilometer water network. The sensors are affixed to the pipes, either on hydrants or other above-ground equipment, at roughly 300-meter intervals throughout the grid. According to Mr. Yeres, the sensors activate late at night, when background noise is at a minimum, and remain active for just five minutes to conserve battery life. They capture sound patterns in water pipes, allowing early detection of leaks and other irregularities. Mr. Yeres expects the full sensor deployment to be completed within the next 18 to 24 months.

Mr. Yeres described sensors and analytics as complementary, providing, respectively, the micro and macro views of operations. "[The sensoring] is something that gives us the very close, high resolution, very focused close-in type of radar sweep, while the analytics solution provides an around-the-clock monitoring of our system but on a larger scale. Utilizing the two, we [get] a good feel of what's happening in our system," Mr. Yeres explained.

## Improved Valves

In the pursuit of decreased NRW and better profits, Mr. Yeres indicated that low-tech solutions also play a part in Hagihon's improved processes. He gave the

example of a UFR valve system, saying it has been effective in reducing NRW by compensating for the under-sensitivity of metering systems, which previously did not detect losses as small as a dripping faucet.

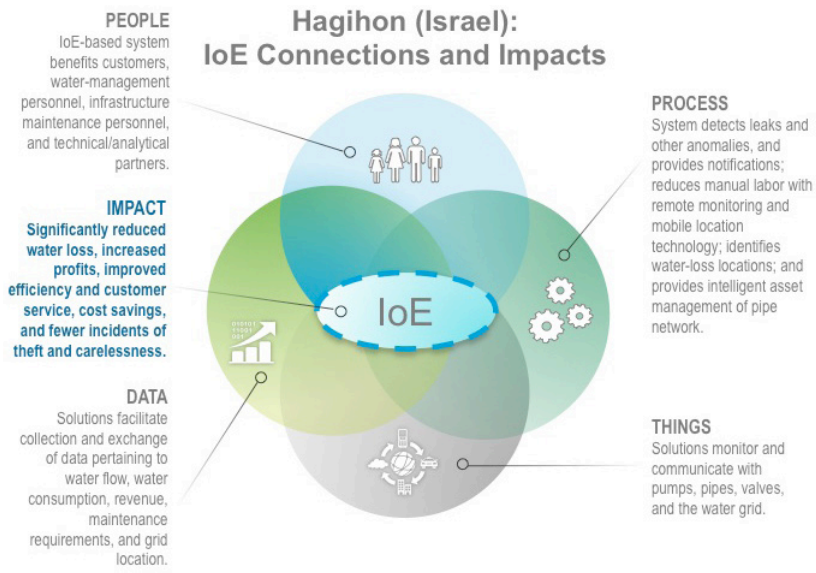
"Utilities all around the world are losing money because water is dripping out there from the customer," said Mr. Yeres. "It's dripping out in various places in the customer's property (leaky faucets, dripping showers), below the sensitivity of the water meters. Thus, that is water consumption that we paid for (to Mekorot) and we were not able to collect from the customer. Now it is registered and we collect for it."

### Additional Technology

Mr. Yeres indicated that Hagihon is employing additional technologies, including an ERP system and allowing field employees to utilize mobile phones to record water system survey data. Additionally, Hagihon has developed a mobile phone application that serves the technician installing a new meter when required. The system allows submission of meter photos and location data (as required by regulation) electronically by the technician to the Hagihon SAP ERP system.

Mr. Yeres listed the decrease of NRW by several percentage points and the corresponding increase of profits as the major benefits associated with the technological improvements to date.

Figure 1. Hagihon: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

Mr. Yeres listed the decrease of NRW by several percentage points and the corresponding increase of profits as the major benefits associated with the technological improvements to date. "At the end of the day," he said, "the basic metric that we see is the lowering of water loss. This is a major issue. We are achieving very low NRW – relatively low NRW by I would say global standards. In

most of the city, where we can work freely and implement without difficulty, our NRWs are really around 5 to 6 percent, which is a number we like. That is one of the things that we see getting better and better using technology. The other is increased profitability."

Increased efficiency is another advantage of Hagihon's strategy, with sensors doing data collection previously conducted manually. Maintenance personnel are dispatched electronically for inspection when sensors detect an anomaly in the water system, resulting in quicker repairs and reduced NRW. While water meters are still visually inspected for readings, data is transmitted via GSM rather than transported by the reader.

In addition, the sensoring system eliminates the need for monitoring staff and onsite accommodations. "In the old-fashioned world, I had a person in my control room looking at the screens all day," Mr. Yeres explained. "Now that is no more. We do not have any more control room, we do not have an engineer sitting and looking at the gauges. Now any anomaly is sent by email or SMS to the mobile phones of the various engineers who decide it, and they get an alert that something is going on."

"In the old-fashioned world, I had a person in my control room looking at the screens all day. Now that is no more. We do not have any more control room, we do not have an engineer sitting and looking at the gauges. Now any anomaly is sent by email or SMS to the mobile phones of the various engineers who decide it, and they get an alert that something is going on."

Joshua Yeres,
Director of Business Development,
Hagihon

Mr. Yeres found an unexpected advantage in sensoring: in addition to early detection of maintenance issues, it also provides opportunities for improved customer service. "While the system was supposed to identify hidden leaks, we discovered that it provides additional benefits," he said. "For example, if there are leaks even after the water meter – meaning already in the private property of the consumer, where I don't care about it because he is going to pay me for it – now I can also provide a level of consumer relations and say, 'So-and-so, you have a leak somewhere on your property.'"

Mr. Yeres indicated that alerts of unusual water-flow activity have reduced incidents of theft and carelessness. Mr. Yeres gave an example of one consumer caught filling his swimming pool from the fire hydrant early in the morning. Other spikes have alerted workers when valves are left open. "So you have here another dividend," said Mr. Yeres. "It's not just water loss, it's also work clarity. It's being able to follow what's going on."

Hagihon is emerging as a recognized leader in innovative water management strategy, and press is highly positive. The company actively engages in promoting these strategies, and regularly provides interested water utility delegations with tours of its facilities. Hagihon also hosts formal training events, including workshops for large groups of senior water managers. Hagihon is interested in collaborating with global and local system and technology providers in the development of innovative water-related technologies.

Hagihon professionals assist in international development projects. They are active partners in the SAFEWATER initiative for developing an affordable detection and management solution for safe drinking water, and were represented on the Israel WATEC 2013 steering committee.

Hagihon received a Top 5 ranking from the European Innovation Partnership Water Action Group, as well as a WEX 2014 Global Innovation Award for Operations.

## Lessons Learned / Next Steps

Mr. Yeres described his biggest challenge as the introduction of cutting-edge innovation in an environment he describes as "very conservative" and "suspicious of technologies." In addition to resistance by union management, Mr. Yeres said introducing cell phones and laptops as tools to workers more accustomed to wrenches and analog gauges has been a slow process. "For them to start using tablets and interface with computers is something that is strange to them, very difficult for them," he said.

Mr. Yeres explained the impact of this issue. "We are slowing down the implementation in order to get people on board, and this is not a trivial matter," he said. "To go to the middle-level management and say, 'Guys, when you get to work in the morning, open up your computers and look what's happening in your area on your [analytics dashboard],' this is something that these people never did. This is an issue that has to be related to, and we are relating to it and trying to make it user-friendly for all to get over their hesitation about these things."

Mr. Yeres described his biggest challenge as the introduction of cutting-edge innovation in an environment he describes as "very conservative" and "suspicious of technologies."

Ms. Yeres noted that the proliferation of sensoring technology requires corresponding access to power supplies, which introduces other challenges. "You've got more sensors, you're going to need electricity. You've got to find somewhere to do that," he said. "If I want to put sensors all over the place, either I'm going to be using up a lot of batteries or I have to find alternative sources or sustainable sources." Mr. Yeres finds the issue particularly challenging in remote areas, and described solar-powered devices as problematic due to the complexity of obtaining required permits.

Although he is interested in pursuing remote water-metering technology, Mr. Yeres said the likelihood is complicated for a number of reasons. He listed one as budgetary concerns. "We've come to the conclusion that it is really a very expensive item for the number of meters that we need, because we're regulated and we cannot charge whatever we charge, even though it might give us certain efficiencies in the future," he explained. Mr. Yeres said that cultural concerns among Orthodox Jews introduce another complexity, as the sending of an electronic signal is prohibited on the Sabbath.

Mr. Yeres hopes to explore further integration of processes into the analytics web-based solution, calling the integration so far as "the main achievement." He said, "People are using [the solution] as their major screen. Everything else is going to have integrate into that because I don't want people opening up five different screens."

Mr. Yeres has additional plans for improvement of the site, saying, "We are at a stage where we've asked them, and they are developing for us improved HMI, Human Machine Interface, where there are various dashboards for various levels of professionals. What the CEO wants to see on his computer is not the same thing as an area facility manager has to see on his computer. We are working together with [the analytics provider] to tailor-make the screen – the dashboard for the various levels of management – according to their particular needs."

"Do not be afraid of new technologies. The future and lower costs can be achieved with smart networks. Even though implementation of new, innovative technologies can sometimes involve periods of trial and error, we find that the dividends by far outweigh the risks."

Joshua Yeres,
Director of Business Development,
Hagihon

Mr. Yeres would like to pursue further implementation of sensoring and integration programs. "We're looking for additional technologies to get a better hold of our system, to provide better coverage." He mentioned sewage flooding and industrial waste as possible areas for growth.

Hagihon is also currently looking at ways to power sensors located throughout the water grid. Various technologies each have their difficulties, such as the requirement for battery replacement or the lack of an electric connection in a rural area, but one technology that may have some promise is the installation of small electric turbines in water pipes to create enough energy to power a sensor via the regular flow of water through the pipe.

For those seeking similar improvements, Mr. Yeres counseled both persistence and fiscal caution. "Rome wasn't built in one day," he said. "Water companies are big systems, and you have to set your objectives, set up a plan. It's a long process, so keep to it, because no water company has an unlimited budget. You're working with early-stage companies [and] with technologies that haven't been tested. You have to make sure that your budget is enough for the extra man-hours, for the extra pieces putting together the extra integration. Because as we've seen, it's almost always above budget."

Mr. Yeres concluded, "Do not be afraid of new technologies. The future and lower costs can be achieved with smart networks. Even though implementation of new, innovative technologies can sometimes involve periods of trial and error, we find that the dividends by far outweigh the risks."

## More Information

For more information, visit http://www.hagihon.co.il/?nodeId=13

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# Port of Hamburg Relies on IoE Capabilities to Improve Management of Waterways, Roads, and Rail

## EXECUTIVE SUMMARY

### Objectives

- Develop a strategy to maintain, modernize, and constantly improve HPA's infrastructure
- Enhance the quality of life for citizens in the vicinity of the Port of Hamburg

### Strategy

- Develop a more intelligent harbor operation through implementation of an Internet of Everything model

### Solutions

- Extensive systems for waterway, train, and road traffic management

### Impact

- Sensors enable HPA to make smarter decisions: people receive data at the right time so they can invoke the proper processes when needed
- Integrated traffic management system (waterways, roads, rail) allows port to manage bridge closures and the roadway congestion that tends to increase when ships are offloading

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About the Hamburg Port Authority

Hamburg, Germany, is inconceivable without its port. In the middle of the city, the port occupies about one-tenth of the total city area (7,145 hectares, or 17,655 acres) and is the backbone of business in Hamburg. The Port of Hamburg is creating jobs, income security, and growth in the region. The port benefits not only the city and the metropolitan region, but the entire German economy as well. The numbers speak for themselves: about 261,000 jobs are dependent upon the port throughout Germany. The Port of Hamburg is also an important pillar of exports and an infrastructure hub of cross-macroeconomic importance.

"The reality is this: The reason we would look for [a] holistic model is that we have all this business going through the city, but it impacts the citizens. To create a model where we are able to do this without negatively impacting the citizens and the city itself is our goal."

Dr. Sebastian Saxe,
Chief Information Officer,
Hamburg Port Authority

Since 2005, the Hamburg Port Authority (HPA) has been providing future-oriented port management services that offer one face to the customer. As an institution under public law, the HPA is in charge of paving the way for the efficient, resource-friendly, and sustainable implementation of infrastructure projects in the port. The HPA is the contact point for all kinds of questions concerning waterside and landside infrastructure, the navigational safety of vessel traffic, port railway facilities, port property management, and economic conditions within the port area. The HPA ensures the provision of land as required, carries out all statutory duties placed on it, and provides port industry services.

Dr. Sebastian Saxe is chief information officer for the Hamburg Port Authority. He has a background in mathematics and has worked in the healthcare sector previously. Dr. Saxe initially entered the public sector by working in geographical systems, then entered several IT roles. His current focus is looking into innovative ways the government can use technology – including everything from voice over IP (VoIP) to core networks and beyond – to improve people's lives. He also functions as the IT procurement executive for HPA and deals with compliance issues. He has been at HPA for five years, since the beginning of its smartPORT project.

HPA IT Director Ulrich Baldauf works with Dr. Saxe on smartPORT strategy. Together, they oversee the smartPORT logistics project for the Port Authority and the city of Hamburg.

## Objectives

Dr. Saxe's primary objective is to develop a strategy to maintain, modernize, and constantly improve HPA's IT infrastructure. Efficiency is a core objective for HPA, as an efficient port and transport network promotes economic development and pleases the citizenry. "We have to make sure trains and vessels are running, and streets are not blocked; we have to make sure everything runs efficiently," Dr. Saxe explained.

Improving the quality of life for citizens around the Port of Hamburg is another priority. "The reality is this," continued Dr. Saxe. "The reason we would look for [a] holistic model is that we have all this business going through the city, but it impacts the citizens. To create a model where we are able to do this without negatively impacting the citizens and the city itself is our goal."

According to Dr. Saxe, years ago the city realized that efficient port operations weren't just a question of IT architecture – there was a need to improve the overall process. That generated the push toward implementing the concept of connectivity and sensors. In 2009 and 2010, HPA started to build the foundation for connectivity implementation.

Growth and planning for growth are extremely important to the port. According to Dr. Saxe, one of his major objectives is to anticipate and keep pace with growth in the number of containers coming into the city through its port. He looks not only at capacity, but also at business process and augmentation to make sure what works today can be scaled for the future.

Ultimately, the long-term goal is to have a more intelligent harbor operation, and to have more proactive control through implementation of an Internet of Everything model. "We'd like to be able to be more proactive with our traffic-control systems," said Dr. Saxe, "so we evolve to have more intelligent systems based on what we have our systems telling us now. We are striving for a smartPORT Hamburg so the whole ecosystem and operation is more intelligent."

According to Dr. Saxe, years ago the city realized that efficient port operations weren't just a question of IT architecture – there was a need to improve the overall process. That generated the push toward implementing the concept of connectivity and sensors. In 2009 and 2010, HPA started to build the foundation for connectivity implementation.

## Strategy

Starting in 2009, Hamburg Port Authority began upgrading its core information technology infrastructure, a move that has allowed the port to develop sensor-based applications to monitor traffic coming in and out of the port area, including both land- and water-based traffic. The initial IP-based sensor project started in 2011 and included sensors in roadways and bridges. Currently, HPA is working to include smart lighting applications to help HPA management in their decision-making capacity. Additionally, much of the information gathered is now being transmitted publicly to improve traffic flow and citizen awareness throughout the city.

## Solution

For Hamburg Port Authority, the journey began with the internal IP network infrastructure. As HPA thought about connecting things and building intelligent systems, it became clear that the organization was missing the core network on which to build. With assistance from private-sector network technology and energy management firms, HPA developed a fiber-optic backbone by consolidating four distinct networks.

According to Dr. Saxe, 2011 was when HPA really entered the Internet of Everything era. That year, HPA built its first higher-level, broad-based application that leveraged the initial network upgrade: a traffic management system. HPA installed 300 roadway sensors to monitor traffic across major roadways in the port area. Based on its accumulated knowledge and experience, HPA is now expanding and installing new sensors in the port area for different purposes.

The initial network has since been expanded to include a broader network throughout the port area, as well as Wi-Fi hotspots in strategic locations, with the assistance of a network firm and a local telco. In the future, HPA plans to expand and upgrade the system so that all the information – sensor data, video, photos, and other pieces of data – feeds into a central management hub. Once a robust volume of data has been accumulated, HPA anticipates building an intelligent system that can quantify what is going on and help analyze the best way to manage the different systems of transport.

## Road System

All of the road sensors are connected via an IP network to monitor traffic flow. The Port Road Management Center receives the data, which is then analyzed via algorithms to determine traffic speed, congestion, and significant issues. The system does not provide active traffic management, but currently serves as a monitor of what is happening on the roads and bridges. The system also monitors vehicle weight, which helps determine how much traffic has crossed a bridge, informing bridge design, maintenance, and renovation schedules.

HPA is currently piloting a solution tht would integrate with roadway traffic data to help manage traffic disruptions that may occur when ship traffic requires bridge closures around the port area.

HPA then installed large digital billboards to communicate with drivers about delays and traffic patterns. Sensors also provide parking information to drivers via mobile applications that take advantage of GPS-enabled location data. This system has reduced the time drivers spend on the roads looking for parking.

## Waterway System

The Nautical Office manages data collection for waterways, which includes radar and AIS (Automatic Identification System) to monitor incoming ship traffic. This data is fed to relevant departments to alert and prepare them for each incoming ship. HPA is currently piloting a solution that would integrate with roadway traffic data to help manage traffic disruptions that may occur when ship traffic requires bridge closures around the port area.

## Rail System

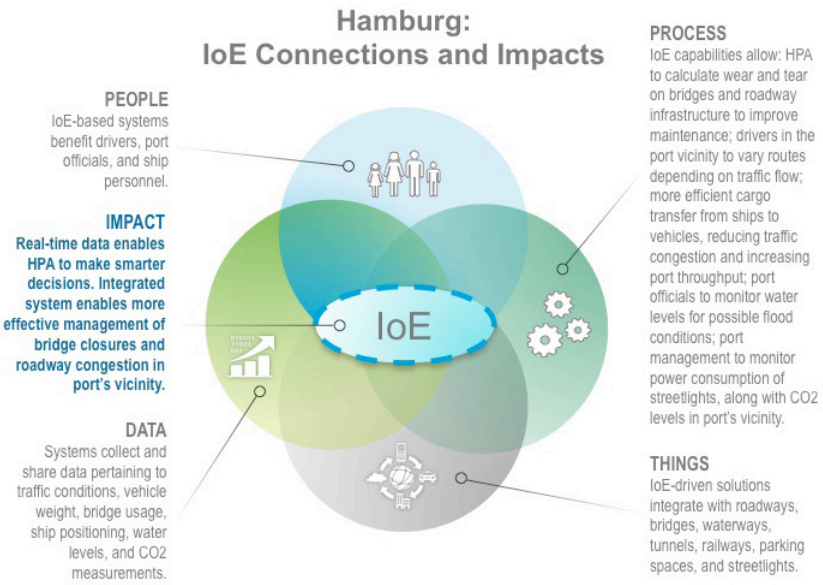
Finally, the Rail Supervision Headquarters oversees management of the rail network within the port area. According to Dr. Saxe, HPA recently implemented a service-oriented architecture (SOA)-based system that is common to the port industry.

HPA also utilizes collaboration technology to facilitate internal video conferences as well as video conferences with customers and partners. Dr. Saxe feels that this technology has added significant value, allowing HPA to collaborate in more effective ways.

According to Dr. Saxe, the Internet of Everything enables people in Hamburg to make smart decisions due to the sensors and systems HPA has in place. For example, when a ship comes into the harbor, HPA's systems indicate that it is approaching. This allows HPA to get real-time information to those who need it, including ship pilots, cargo handlers, environmental monitors, and so forth. People receive data at the right time so they can invoke the proper processes at the right time.

**Figure 1.** Hamburg Port Authority: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

According to Dr. Saxe, the Internet of Everything enables people in Hamburg to make smart decisions due to the sensors and systems HPA has in place. For example, when a ship comes into the harbor, HPA's systems indicate that it is approaching. This allows HPA to get real-time information to those who need it, including ship pilots, cargo handlers, environmental monitors, and so forth. People receive data at the right time so they can invoke the proper processes when needed.

Dr. Saxe indicated that Hamburg's integrated traffic management system allows relevant individuals to begin looking at how, for example, a ship's arrival will impact street and train traffic. When large container ships pull into port, this often requires the raising of bridges, which, depending on the bridge, will stop vehicle or train traffic, or both. Given the added lead time and transport network visibility that the sensor system provides, port officials can manage bridge closures and the roadway congestion that tends to increase when ships are offloading.

Due to HPA's strategic vision and contribution to economic growth, in the last five years, city officials and residents have paid more attention to the technology and programs that HPA has implemented. Technology has now become part of the strategic effort to improve the city's growth and quality of life.

## Lessons Learned / Next Steps

One of the biggest challenges has been demonstrating tangible results of technology, and communicating them in terms the general public will understand. One strategy to address this has been to build small prototypes to show incremental benefits. It is a less comprehensive approach, but allows HPA to highlight project results to generate momentum and support larger implementations.

Another challenge cited by Dr. Saxe has been integrating various technologies and initiatives. Different systems, if kept separate, provide a fragmented picture. Pulling the systems together is a critical step in building overall perspective on port operations. Finding heterogeneous technologies, and integrating technologies into the overall plan, has been more difficult than originally anticipated.

"I have an Oracle database here, a network there, and Microsoft technologies here – getting them to talk to each other can be very difficult at times," Dr. Saxe stated. "For me, candidly, that has been the biggest challenge. I would like to have a blueprint so that I know that the pieces of the blueprint can work with one another. I would like to be able to go to the IT manufacturers that are on my blueprint and ask them how they are supposed to integrate with one another. I would like to incorporate into my plans the trends of social networking and Big Data – how do I understand these trends and how do I incorporate them into my approach so they are not overlooked. If you don't pay attention to all of these, you constantly have to revise your blueprint."

When asked about the Internet of Things and the Internet of Everything, Dr. Saxe stated, "For me, the Internet of Things is just too simplistic. Internet of Things means that we don't bring people and process into the equation of what we are trying to do. Internet of Things for me is just pure technology. It's Wi-Fi, embedded systems, the technology that is out there. The Internet of Everything, on the other hand, incorporates the technology, tries to build a control process, and includes people in this process in order to build more intelligent systems. If you try to approach this type of model and you leave out processes and people, you are going to be left with half-truths, or an incomplete solution."

As for next steps, HPA is attempting to integrate additional sensors into its systems based on initial findings. It wants to place additional and more capable sensors in key hotspots to gain a deeper understanding of what is taking place. HPA also wants to learn more about who is moving where, and when they are moving. According to Dr. Saxe, this will bring HPA into the realm of Big Data. For this step, HPA is currently looking at auto registrations using sensors and images. According to Dr. Saxe, these sorts of higher-level intelligent applications are the future for HPA and are already in the planning phases.

Lastly, among various pilots and test cases that are ongoing, the environment is an area that HPA is beginning to explore, including a smart streetlighting program. HPA views this as another infrastructure building block necessary before moving into higher-level intelligent systems.

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## More Information

For more information, visit http://www.hamburg-port-authority.de/en

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# *Connected Boulevard* Initiative Generates IoE-Driven Benefits for Nice, France





**EXECUTIVE SUMMARY**

### Objectives

- Enhance urban life experience of Nice residents
- Improve city services while maintaining the same cost basis (or by cutting costs)
- Capture new economic development opportunities via open-data sharing

### Strategy

- Attain top-level support to move forward on Internet of Everything applications
- Employ open architecture system that allows addition of new technologies and projects in the future

### Solution

- Ultra-high-broadband network, sensor network, and data warehouse to aggregate data and conduct analyses
- Sensors are placed on waste receptacles, streetlights, and in curbing next to parking spaces
- In addition to monitoring light, streetlight sensors monitor air quality, noise levels, temperature, humidity, and traffic flow
- Sensor data is sent to city's data center via Zigbee and Wi-Fi networks

### Impact

- Smart-parking and smart streetlighting initiatives have shown the most initial promise

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

## About the Nice 'Connected Boulevard' Initiative

The Connected Boulevard initiative implements IoE technology along one of Nice's most prominent boulevards. The program includes applications that monitor parking, lighting, air pollution, and solid-waste levels. The system is currently in active use, with implementation starting in June 2013. The first year of implementation is seen as a trial period to help the city understand which applications may be useful and easily scalable for broader implementation throughout the city.

All programs are operated from the same open IP platform, which allows easy system expansion. The Internet of Everything concept forms a core element of the initiative by providing increased access, monitoring, and control capabilities via open architecture computing and network platforms, and by engaging disparate elements of the city to provide for common improvements.

"The first objective was to improve the urban life experience of our citizens, so that they feel better in the city."

Christian Tordo,
Deputy Mayor,
Nice, France

Christian Tordo heads economic development and digital innovation for the greater Nice Cote d'Azur region.

Prior to his current role, Mr. Tordo worked with Texas Instruments. From 1994 to 2013, he was general manager of Texas Instruments' operations in France, a role in which he was heavily involved with near-field communication (NFC) and wireless technologies. Before his work with Texas Instruments, Mr. Tordo studied at HEC in France, where he earned his MBA.

## Objectives

The Connected Boulevard initiative is an experiment (pilot) to see which benefits can be derived from IoE applications in the city. The goal is to utilize this experiment and the benefits achieved to justify future expansion and further initiatives.

According to Mr. Tordo, innovation was a key piece of the mayor's platform when he was originally elected in 2008. This led to direct support from the mayor for Nice's Smart City initiatives. It also equated to a public mandate for such change. This gave senior city administration officials extra motivation to push forward on initiatives, providing Nice with an advantage over other urban areas in terms of Smart City implementation.

According to Mr. Tordo, Nice began to pursue its technological focus in earnest following the election of the current mayor in 2008. Before 2008, Nice had earned the reputation as a somewhat "sleepy city." A pillar of the new mayor's platform had been to change Nice's global image and place the city among the most dynamic in France and Europe. With central government support, Nice began a new sustainability initiative, along with a new tech initiative, all aimed at improving the city's image among its own citizens and beyond. According to Mr. Tordo, this top-down, strategic approach was critical to ensuring support for the initiatives that were to follow.

Mr. Tordo stated that the Connected Boulevard initiative has three main objectives:

1. Improve the urban life experience of Nice residents
2. Improve city services while maintaining the same cost basis (or reducing costs)
3. Capture new economic development opportunities via open-data sharing

"...there was strong leadership from the mayor on this project, so all people understood that it was backed by the mayor, by all the key elected executives. The matter was not whether we do it or not, but how can we implement. That's where the city administration plays a role."

Christian Tordo,
Deputy Mayor,
Nice, France

## Strategy

Nice's efforts toward becoming a smarter city originated with the election of a mayor whose platform included developing a new image of sustainability and innovation for the city. Top-level support has been key in Nice's moving forward on Internet of Everything applications in the city.

Nice IoE projects have included an initial virtual city hall project, which allowed residents to interact with city officials remotely. This was followed by the higher-profile "Connected Boulevard" initiative, which includes a smart parking system, smart streetlighting, smart waste management, and environmental monitoring.

City officials started with a vision of having an open-architecture system that would allow them to add new technologies and new projects in the future.

The primary challenge of the initiative was garnering cooperation from lower-level city management personnel. These administrators first had to be convinced of the validity of the initiative, and then they needed to help solve the various issues surrounding implementation.

The project has been fully directed and owned by the city. All hardware, software, and equipment involved in Connected Boulevard is owned by Nice and managed the city's partners. Nice has the option to add applications as it sees fit. The city manages the infrastructure and collects the data, which is then shared openly (for example, via a parking app in the case of the smart parking system).

The Connected Boulevard initiative is paid for with public funds, utilizing allocations from the city's overall budget. According to Mr. Tordo, given the political backing from the mayor, the budgeting process has been relatively simple from the beginning. The key point to note is that given Connected Boulevard's experimental status and the pending June 2014 review, the ability to document benefits will play a significant role in terms of the amount of the city budget available for future phases or expansion.

## Solution

Nice's city technology architecture is based on four layers:

1. Ultra-high broadband network
2. Sensor network to gather data
3. Data warehouse to aggregate data and conduct analyses
4. Services and applications that communicate and automate response to data

According to Christophe Junac, director of digital Innovation for the city, the Connected Boulevard project is seen as a test of the first two layers, and the extent to which the data could be useful for improving city management and enhancing quality of life in Nice.

The Connected Boulevard project involved the installation of sensors throughout the Victor Hugo Boulevard area. These include sensors on waste receptacles, on streetlights, and in curbing next to parking spaces. In addition to monitoring light, streetlight sensors also monitor air quality, noise levels, temperature, humidity, and traffic flow. Data gathered from the sensors is sent to the city's data center via Zigbee and Wi-Fi networks. The establishment of the Wi-Fi network has provided added benefit by allowing city employees to access the city intranet from various locations around the city.

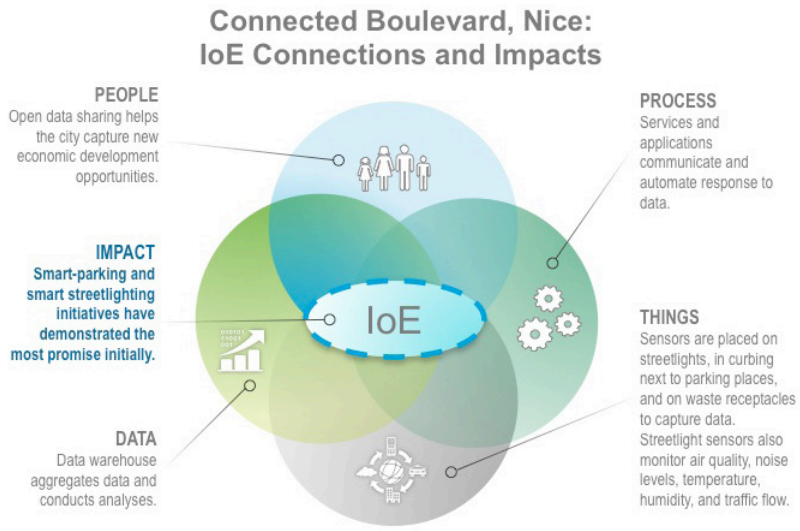
"We wanted this project to be technologically agnostic from the city's standpoint. We wanted, obviously, not to be bound to a proprietary solution with hardware or software, and to be able to have it open enough so we can add features and use it as we wish."

Christian Tordo,
Deputy Mayor,
Nice, France

According to Mr. Tordo, Nice's administration wanted this project to be technologically agnostic from the city's standpoint. The platform is open, and applications can be added. "We wanted, obviously, not to be bound to a proprietary solution with hardware or software, and to be able to have it open enough so we can add features and use it as we wish," Mr. Tordo explained.

Nice initially implemented its "virtual city hall" kiosks by hardwiring a touchscreen display system to the telecommunications backbone at various shopping malls. These terminals would then provide a live video-conference connection to a city employee who could assist with conducting various services. The kiosks would also provide a Wi-Fi hotspot to those in the area.

**Figure 1.** Nice, France: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

Broadly speaking, Mr. Tordo stated that his government has recognized two unique and unforeseen benefits of the Nice Smart City initiatives. The first is that the coordination across governing bodies required to implement the projects has created a more "transversal" governing structure (i.e., eliminated departmental silos within city government). This has greatly enhanced the municipality's ability to operate effectively. "We tried developing a key element to fight silo management with our Connected Boulevard experience. It has become a positive side effect of our willingness to play a very active role in the smarter city initiative," Mr. Tordo stated.

Referring to the specific applications that have been implemented in Nice, Mr. Tordo indicated that the smart parking and smart streetlighting initiatives have shown the most initial promise.

The second unanticipated benefit was a sense of what Mr. Tordo called "mutualization," or the move toward a common architecture and systems framework across departments. This move has also helped eliminate departmental silos.

Referring to the specific technology applications that have been implemented in Nice, Mr. Tordo indicated that the smart parking and smart streetlighting initiatives have shown the most initial promise. "In our vision, smart parking is just one brick in the total wall we would like to build, and in the ultimate services we would like to offer citizens," he stated, referring to the goal of providing additional analytics and solutions to help residents pick the most efficient transportation methods in real time. Mr. Tordo indicated that smart lighting also shows clear benefit because it is easy to track the cost savings associated with a dynamic lighting system.

Mr. Tordo averred that it has been more difficult to document quantifiable benefits associated with environmental monitoring and waste management projects. He indicated that, in June 2014, there would be an assessment of the project as a whole to identify all benefits and value added by the various projects.

## Lessons Learned / Next Steps

Asked what advice he would give other city leaders seeking to implement similar Internet of Everything type initiatives, Mr. Tordo said it is very important to determine what is important to the citizens and to understand their expectations before deciding on an application. "The prime objective was to improve the urban life experience, and I think this is a key element in any initiative in that area," he explained.

Mr. Tordo indicated that the Connected Boulevard project will reach its one-year milestone in June 2014. At that point, the government intends to evaluate results and determine next steps. Initial indications, though, are positive, particularly on the smart parking and smart streetlighting portions of the project. Mr. Tordo stated that the next vision is to look for ways to more proactively utilize the parking data that the system is collecting and integrate it with traffic management to provide added analytical services and information to city residents.

Nice's administration has a broader vision to link traffic predictability with public transportation information to give citizens real-time information on the fastest method of transportation to their desired destination.

Nice's administration has a broader vision to link traffic predictability with public transportation information to give citizens real-time information on the fastest method of transportation to their desired destination.

Mr. Tordo foresees broader application and development of current initiatives once the June review is completed. By that time, he hopes that the "experiment" will have gathered the necessary data to convince the citizens of Nice to feel the same.

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# IoE-Driven Smart Street Lighting Project Allows Oslo to Reduce Costs, Save Energy, Provide Better Service

**EXECUTIVE SUMMARY**

### Objectives

- Control lighting and electrical costs
- Become more energy efficient and environmentally friendly

### Strategy

- Use mayoral support to generate funding
- Change EU law that did not allow dimming of streetlights

### Solution

- Monitor and control lighting levels from any Internet-connected location
- Enable automatic "dimming" of streetlights during dawn and dusk time periods to save costs and energy
- Brighten or dim streetlights based on weather conditions or special needs

### Impact

- US $1.3 million in electricity savings annually, which is roughly 20% of the cost to light streets prior to the new capabilities being added
- Reduced maintenance costs and improved lighting service
- New system will pay for itself in less than three years

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

 

## About the Oslo Smart Street Lighting Project

The Oslo Smart Street Lighting project is an evolving citywide initiative to improve the efficiency of the city's streetlighting system. Oslo connected the city's streetlighting into a single, remotely accessible network that allows monitoring and control of streetlighting levels through Internet-based applications. Future vision for the project includes installing sensors in the lights that will enable automatic lighting control based on weather conditions, street use, and natural light availability.

Oslo's smart streetlighting system incorporates 650 processing stations (cabinets) that connect to 65,000 light points in the city. The cabinets each collect data and allow control of 5 to 30 different lights via hard-wired connections across power lines connected to the lights. The cabinets then connect to central lighting system servers via ruggedized GPRS modems. Through this network, light output is remotely accessed and controlled using Internet-based interfaces.

"We wanted to take more control of the lights. That is where we started this project: finding a system that enables us to dim our lights and also have control over how much electricity the lights are using."

Joakim Hjertum,
Head of Section,
Oslo Street Division

Joakim Hjertum serves as head of section for the city of Oslo's Street Division. He is responsible for street maintenance and overall operation of the street system. Mr. Hjertum has been with the Street Division for eight years, and began working there after receiving an undergraduate degree in engineering.

Mr. Siamak Vafa is the chief engineer for Oslo's Street Division.

## Objectives

According to Mr. Hjertum, prior to the Smart Street Lighting project, the Street Division paid the electric company to install and maintain streetlighting for the city. This arrangement left the city with little control over lighting levels, and little incentive for the electric company to look for efficiencies. "We were paying a lot of money and we had no control over the things we owned because, over the years, we had paid the loan on the streetlights; we owned the lights, but we had no control over them," Mr. Hjertum said. "A couple of years ago, the city of Oslo took control of the streetlights [from the electric company] and started upgrading the entire system. One of the main issues that we focused on was monitoring our streetlights. We had no control and didn't know how much power they used. We had absolutely no control of our lights at all."

Initially, Oslo's desire to become environmentally friendly also drove the initiative. According to Mr. Hjertum, city research concluded that Oslo used "way too much light. We don't need that kind of light for the road to be safe – especially during some parts of the day when you can have lower light and still have enough. We figured out that you can dim your lights just as you dim them in your house – they don't need them to be fully lighted all the time. That is where we started this project: finding a system that enables us to dim our lights and also have control over how much electricity the lights are using."

 

## Strategy

The project received some funding from the European Union as an environmentally friendly initiative, and the project was championed by Oslo's mayor based on his green agenda. Additional funding came from the annual city budget. The installation costs of the system were between 18 and 20 million Norwegian kroner (US $3 million to $3.3 million).

Oslo backed the Smart Street Lighting project because of the environmental, energy-saving benefits and changes to EU laws, but the cost-saving component was an unseen benefit; electrical bill savings allowed the streetlight system to be updated and better maintained. "We are still using money in the maintenance [of the system] because we want to have a high standard on our streetlights," Mr. Hjertum said. "So the money we have saved on our electrical bill we have used on maintenance and other upgrades in the light system."

"Our mayor was very fond of this, and he also saw the potential energy savings. He took this project forward and gave us a lot of money to do this because he saw that in the end, it was Oslo leading the way. He also saw that it was a way to highlight Oslo and make it an enironmentally friendly city."

Joakim Hjertum,
Head of Section,
Oslo Street Division

The Oslo Smart Street Lighting project operations and maintenance is administered by the Oslo Street Division, which is overseen by the local city government. The city provides funding through its annual budget. The city of Oslo owns the hardware and infrastructure for the project.

"Our mayor was very fond of this, and he also saw the potential energy savings," Mr. Hjertum explained. "He took this project forward and gave us a lot of money to do this because he saw that in the end, it was Oslo leading the way. He also saw that it was a way to highlight Oslo and make it an environmentally friendly city."

Because this is a municipal project providing a basic service, Mr. Hjertum does not think the whole citizenry is aware of the changes. But, he says those knowledgeable about the project have been happy about it. "I think people are happier because we can now deliver more for our money and we can fine-tune our maintenance. People see that we fix faults faster." Generally, Mr. Hjertum indicated that public engagement has not been a large part of this project, other than to help market the concept of Oslo being a green city.

## Solution

The Smart Street Light system, which began in 2011, includes 650 processing stations (cabinets) that monitor more than 65,000 streetlights. The processing stations and lights are controlled remotely by administrators via Internet-based applications. City officials can control lighting levels and the timing of light adjustments via computer workstations, tablets, or even smartphones. The system also provides maintenance data, such as bulb replacement information, to better enable city officials to provide systemwide maintenance and servicing.

According to Mr. Hjertum, the new lighting system has connected city officials to the actual lights in ways that did not exist previously. Now, city officials can view status of individual lights from an Internet-enabled terminal. Previously, city officials had to drive to the specific light location in order to see if a light was on. This has vastly improved the maintenance capabilities of the city because it learns about outages and burnouts much quicker, in real time. "We have saved a lot of money on this

 

because we are now able to put the maintenance efforts where we need them and be more effective with what we need to do," said Mr. Hjertum. "We know that a bulb has been illuminated for [a length of time] and now know when we need to change it before it goes black .... Now we know exactly and we pay for the exact use and not for theoretical use."

The city uses the dimming feature to save electricity by changing the lighting levels depending on time of day and the amount of natural light. It can also increase or decrease light levels in certain areas based on a particular need, such as incident response or large-scale activity. The previous system was either fully on or fully off, which, according to Mr. Hjertum, resulted in significant energy waste because the lights were turned on at full power during dawn and dusk periods, when lower levels of lighting were sufficient to meet the city's safety and security needs.

"We can override the normal procedure," Mr. Hjertum explained. "If we know that a day will be cloudy, we can turn the lights on earlier and more heavily. So the system is 99 percent working on its own and we are just going in and checking it and making fine, small adjustments when we want to. It's no problem in the system if, on a certain stretch of lights, eight are dimming down but two lights in the road crossings are at max all of the time."

The city uses the dimming feature to save electricity by changing the lighting levels depending on time of day and the amount of natural light.

The system also allows the city to monitor how much electricity it is using for its streetlights, which has helped to cut costs because city officials have more insight into how much energy the system is using and how different conditions and lighting levels achieve the city's lighting goals.

The City of Oslo has a maintenance team that services the lights ias well as the network. In the case of significant network issues, the city brings in suppliers to assist in maintenance and repairs. One important technology issue was the challenge of ensuring that the outdoor cabinets were sufficiently ruggedized to withstand Oslo's climate. Frost and freezing temperatures required that the cabinets be heated. Initially, the heating element on the cabinets started melting surrounding cabling. That problem has since been solved by reconfiguring the cable layout. In addition, the antennae for the system had to be moved outside the cabinet due to too much electrical interference inside.

Mr. Hjertum indicated that the system initially included street-level sensors that changed lighting levels dynamically, based on monitored traffic conditions. It also included other sensors to monitor natural light levels. According to Mr. Hjertum, these sensors had a number of difficulties and faults. Consequently, the project scope was scaled back to simplify the effort and "take smaller steps," although he anticipates that "the next phase of reducing our costs will be to get our lights exactly where we need [them]."

 

Mr. Hjertum indicated future tech expansion would likely include the ability to control each light individually (versus controlling groups of lights), and the ability for each light to dynamically light according to lighting and weather conditions sensed through a monitoring system. While city officials can do this now via the control features added to the lights, having an automatic system would provide an added benefit. Mr. Hjertum indicated that given the open architecture of the system, installing sensors and implementing such capability is relatively simple.

**Figure 1.** Oslo: New and Better Connections.


Source: Cisco Consulting Services, 2014

According to Mr. Hjertum, the biggest benefits from the new system have been the added lighting control and system feedback capability, both of which have contributed to cost reductions. The city is now saving approximately US $1.3 million annually on electricity costs.

## Impact

According to Mr. Hjertum, the biggest benefits from the new system have been the added lighting control and system feedback capability, both of which have contributed to cost reductions. The city is now saving approximately US $1.3 million annually on electricity costs.

Maintenance of the streetlight system has also become easier and cheaper. A significant aspect of this is the ability of the application to remotely pinpoint malfunctioning or dead streetlights. “We know when the lights are illuminated or when they are not working,” Mr. Hjertum said. “So instead of driving around, looking up in the sky to see where there are black lamps, we can just go to our map and we can get the specific info on each lightbulb point, when it goes black, when it gets fixed; we have a complete history on the lighting system.”

Other less tangible benefits include the ability to vary streetlighting levels during specific periods of high need, such as when an accident occurs. City officials can turn lights up or down in response to various incidents to enable emergency personnel or construction crews to work more effectively.

 

## Lessons Learned / Next Steps

Mr. Hjertum says a key lesson learned was the difficulty of being a pioneer in the field, and dealing with unforeseen issues such as customizing the housing cabinets for optimal usage. “It is tough to be the first to do things and be a pioneer, but it is also fun,” Mr. Hjertum said. “You learn a lot and you get a lot of acknowledgement in different areas and different forums.”

Another lesson has been the ability to take control of the city’s streetlight system autonomously, rather than relying upon the electric company, because, according to Mr. Hjertum, “they want to make the most money and are not very fond of efficient lighting and reducing costs.”

“We are saving money, we are saving electricity, and we are getting more environmentally friendly. You can save big money by doing this, and you get control. Internet is the future, and this is the way to do things.”

Joakim Hjertum,
Head of Section,
Oslo Street Division

In the future, Oslo wants to incorporate a counter to measure electrical use in each light point and have the ability to communicate directly with each light point. “After that, we [will] have the controls in the cabinet controlling a lot of lights. We want to put those in each light point and have a direct connection to each light point, and dim those completely dynamically [so that we can] be completely reliable in everything.”

By using these dynamic controls and sensors, the city also wants to utilize the accuracy of lighting depending on weather and traffic. This will also require use of sensors to measure actual natural light in locations around the city at any given time. “What would be really nice is if in the middle of the night when there are no cars, you can dim the lights down,” Mr. Hjertum says. “A sensor picks up a car coming and you can turn the lights up.” This will allow optimal energy efficiency and cost saving for the city within its streetlighting system.

“We are saving money, we are saving electricity, and we are getting more environmentally friendly. You can save big money by doing this, and you get control. Internet is the future and this is the way to do things,” Mr. Hjertum concluded.

## More Information

For more information, please visit http://dynamiskgatebelysning.no/en/

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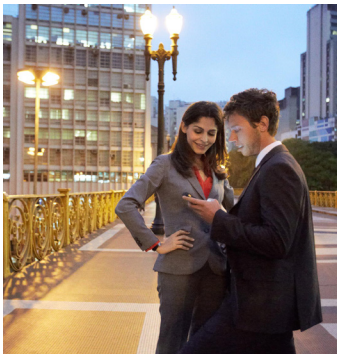
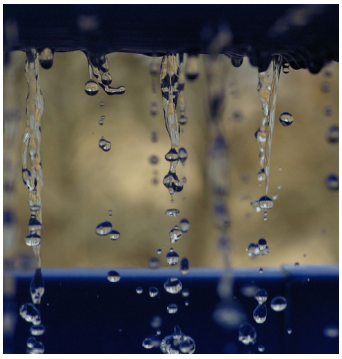
# IoE-Driven *SmartSantander* Initiative Reduces Traffic Congestion, Pollution, Commute Times







SmartSantander

**EXECUTIVE SUMMARY**

### Objective

- Improve city operations and overall quality of life, while maintaining current costs

### Strategy

- Secure top-down leadership and support from Santander's mayor to bridge gaps between different departments and help create more transversal government operation
- Leverage relationships with local universities to expand technical capacity and develop additional applications

### Solution

- Citywide initiative that includes network of more than 25,000 sensors that monitor traffic levels, public transportation options, noise and particulate levels, lighting levels, water quality, and parking availability
- System also provides open access to the data and allows city residents to interact remotely with city officials

### Impact

- 80 percent reduction in downtown traffic congestion due to smart parking application. This has reduced travel times and environmental pollution.

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

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The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

 

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## About Santander

Santander is the capital of the autonomous community and historical region of Cantabria, situated on the north coast of Spain. Located east of Gijón and west of Bilbao, the city has a population of 178,465 (2013). Three years ago, the city began an initiative called "SmartSantander" to improve city operations and the overall quality of life for its citizens.

José Antonio Teixeira Vitienes currently serves as general director of innovation for the Santander City Council. Mr. Teixeira manages all technology for the city, including overseeing both the ICT and Innovations Department and the Smart City Department. When Santander's current mayor was elected, Mr. Teixeira was brought to lead efforts to modernize the city's technological infrastructure and to develop Smart City applications.

Mr. Teixeira is a telecommunications engineer and previously worked for a variety of companies related to the ITC sector. He has been in his current role for three years, since the beginning of the SmartSantander project.

"A project that does not have the leadership of the mayor is a dead project. Leadership is fundamental."

José Antonio Teixeira Vitienes, General Director of Innovation, Santander City

## Objectives

Wanting to improve efficiency in the provision of services at the lowest cost possible, the Santander city government identified information and communications technology (ICT) as the way to accomplish this objective. The goal was to improve the quality of life for citizens and to raise citizen perceptions regarding city government and management. In particular, the government wanted to give residents a greater sense of involvement in the operation of the city.

As an ancillary objective, Mr. Teixeira indicated that the city wanted to use technology implementation to help reorganize how the city is run and managed.

## Strategy

Mr. Teixeira emphasized the key role mayoral support provided to the project. "A project that does not have the leadership of the mayor is a dead project," Mr. Teixeira stated. "Leadership is fundamental." He also commented on the important role that universities have played in the Santander initiative, saying, "We have used an asset that all the cities have and that has not really been exploited by them, and that is the universities. At the university there are some highly qualified research departments that, if well used, with a good management model and a well-established work model, provides mutual assistance that is highly beneficial for the city and for the citizens."

Mr. Teixeira also mentioned Santander's participation in a broader European initiative to develop Smart City applications. This helped the city decide which types of projects to pursue initially.

## Solution

SmartSantander is a citywide initiative that includes a network comprised of more than 25,000 sensors. These sensors monitor traffic levels, public transportation options, noise and particulate levels, lighting levels, water quality, and parking availability. The system also provides open access to the data and allows city residents to interact remotely with city officials. The system includes multiple smartphone apps that assist in the data sharing and reporting function.

"Basically what we are seeking is efficiency in the way we provide city services to the citizens based on the use of ICT. We are implementing ICT in all the services provided to the citizens in the city, and through technology we want to allow the citizens to receive the benefits of the improvements in the way the services are provided."

José Antonio Teixeira Vitienes,
General Director of Innovation,
Santander City

According to Mr. Teixeira, 15 gateway receivers positioned throughout the city receive data from the sensors. Each of the sensors communicates with the gateway receivers via Wi-Fi or NFC (TRF) technology. All of these gateway receivers are connected via fiber-optic cable to the central city servers. This has allowed the city to establish a platform for analysis of the data, which, according to Mr. Teixeira, allows the data to be "linked together in a more transversal and efficient way."

Mr. Teixeira indicated that building the infrastructure and the ongoing improvements and maintenance of the project have involved many private companies, which are typically chosen through an open tender and bidding process.

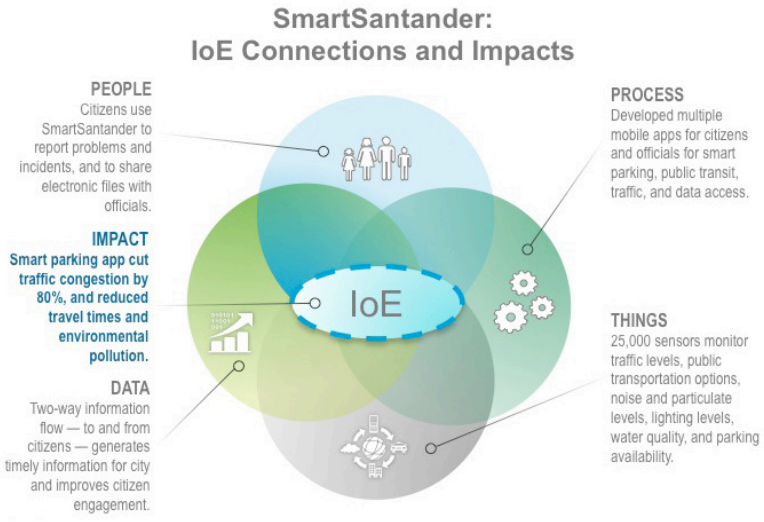
Mr. Teixeira indicated that multiple mobile apps were also developed to help disseminate the data to residents in useful formats. One such app, SmartSantander RA, has been downloaded by nearly 15 percent of city residents. The app provides the timing and location of city buses, traffic information, and also informs residents about cultural events taking place in the city. A second app, City Pulse, allows residents to notify city management of incidents or issues that require attention. In addition to providing a tracking mechanism for addressing these issues, the system includes reporting capabilities. The mayor receives a weekly report on the number of incidents or issues, as well as how many have been resolved and which ones are still in progress. The city has other apps as well, for parking data and water quality measurement.

Ongoing maintenance and system development cost the city of Santander approximately US$2.75 million per year. Recently the city has engaged in public-private partnerships where private companies provide the initial capital to get a project going, then the city and the private partner share in any cost savings or added revenue generation.

The City Council (via the mayor's office) oversees implementation of the SmartSantander project. The equipment, including the sensors, is owned and maintained by the city, with assistance from technology partners. Data gathered via the system is also owned by the city but is shared widely with the general public.

Figure 1. Santander: New and Better Connections.




Source: Cisco Consulting Services, 2014

Mr. Teixeira indicated that due to less time spent by drivers looking for parking spaces downtown, traffic congestion has been reduced by 80 percent. This has not only increased convenience, but also driven reductions in vehicle emissions and fuel consumption.

## Impact

Santander's citizens have generally been very receptive to the government's initiatives, though Mr. Teixeira indicates that helping the public see the benefit of the efforts has been one of the key challenges. Santander City has an active communication strategy that involves close cooperation with the local media.

Mr. Teixeira indicated that due to less time spent by drivers looking for parking spaces downtown, traffic congestion has been reduced by 80 percent. This has not only increased convenience, but also driven reductions in vehicle emissions and fuel consumption.

According to Mr. Teixeira, Santander's Smart City initiatives have not only increased information flow and engagement, but have helped generate a greater sense of transparency in government across the board. Santander is also sharing data with research departments in the local university through a second platform built specifically for this purpose. The hope is that the research departments will be able to assist in better informing the city about other ways services can be improved.

Residents and visitors are the main users of SmartSantander, according to Mr. Teixeira. "They use it a lot," he says, "because we are trying to allow them to participate in everything." This has been important to the success of SmartSantander, as citizens have been able to "buy in" to the project as they see how it positively affects their daily lives.

Residents are also able to interact with city government in new ways. In addition to generating incident reporting, citizens can share electronic files with local governing organizations, check the status of and pay their taxes, and even pay traffic tickets at a discount. “Above all,” Mr. Teixeira says, “one of the important aspects is that they are starting to realize the true benefit of the implementation of ICT for the improvement of services.

“The [public] acceptance has been extraordinary,” he continued. “It is integrating well in the society in Santander and it has made it possible for the city to be recognized worldwide in everything that has to do with Smart City or ICT.” According to Mr. Teixeira, this was in part achieved be showing the public the value of the project from the outset; the initial projects were chosen because of their direct impact on the lives of city residents.

Three key lessons from Santander’s experience include the need for senior leadership and support, a strong tech foundation and system design from the outset, and coordination across various government departments and entities.

## Lessons Learned / Next Steps

Three key lessons from Santander’s experience include the need for senior leadership and support, a strong tech foundation and system design from the outset, and coordination across various government departments and entities.

According to Mr. Teixeira, communication with residents has been the key challenge of the project. Ensuring that they are reaching out and generating interest and support has required concerted effort and attention. “The fear is that we might not be able to have the citizens see the real benefits,” he says.

Mr. Teixeira also mentioned the need to adapt both practices and legislation to bring everything into conformity as another challenge, as well as the challenge of adapting lab models to the real-world environment.

Going forward, the city of Santander plans to implement additional capabilities and to develop better benefit measurement systems.

With help from the EU, Santander also plans to conduct an energy audit for the whole city, to include street lighting and the lighting of municipal buildings. “We are going to create an energy master plan that will mark each of the things that have to be done from now until 2020 to improve the use of energy in the city,” Mr. Teixeira says. “Additionally, with that master plan and with that audit, we will establish a plan to manage the maintenance and the investments that we will need to further improve the energy infrastructure of the city.”

The city is also in the process of installing a free Wi-Fi network for residents and visitors to use at certain hotspots around the city. In the future, the city government plans to identify and implement additional measurement capabilities for tracking additional project benefits. While the city currently measures traffic volume, number of apps downloaded, and the number of city issues raised by residents via their system, Mr. Teixeira indicates there is still work to be done to capture additional data points and measure achievements.

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# IoE-Driven Congestion Charging System Enables Stockholm to Reduce Traffic and $CO_2$ Emissions

## EXECUTIVE SUMMARY

### Objective

- Reduce traffic congestion and improve the environment in Stockholm

### Strategy

- Facilitate cooperation between public and commercial (technology) entities to ensure smooth rollout of system

### Solution

- Impose a traffic congestion and environmental tax on vehicles traveling into and out of central Stockholm
- Use cameras mounted along city streets to track individual and aggregated journeys, allowing for road and public transit planning, as well as real-time traffic management
- Improve efficiency of public transportation by using sensors to track locations of buses throughout the city

### Impact

- 20 percent reduction in traffic within the congestion charge area
- 2 to 3 percent reduction in carbon dioxide emissions
- 10 to 15 percent reduction in pM10-level particulates
- 2 to 3 percent increase in public transportation usage

## Background

In January 2014, Cisco released the results of an in-depth analysis of the economic benefits of the Internet of Everything (IoE) for the public sector. Cisco's model revealed that some $4.6 trillion in "Value at Stake" would result from the adoption of IoE capabilities across 40 key public sector use cases over the next 10 years, including smart water, smart buildings, smart energy, smart parking, and more (http://bit.ly/1aSGlzn).

As a next phase of its analysis, Cisco engaged Cicero Group, a leading data-driven strategy consulting and research firm, to undertake a global study of IoE capabilities across these 40 use cases – how the best public sector organizations are "connecting the unconnected," as Cisco terms it. To that end, Cicero Group conducted interviews with dozens of leading public sector jurisdictions – federal, state, and local governments; healthcare organizations; educational institutions; and non-governmental organizations (NGOs) – to explore how these global leaders are leveraging IoE today.

The research examined real-world projects that are operational today, are being delivered at scale (or through pilots with obvious potential to scale), and that represent the cutting edge of public sector IoE readiness and maturity. The aim of the research was to understand what has changed in terms of the jurisdictions' people, processes, data, and things, and how other public sector organizations can learn from (and replicate) the trail blazed by these global IoE leaders. In many cases, these jurisdictions are Cisco customers; in others, they are not. The focus of these jurisdictional profiles, therefore, is not to tout Cisco's role in these organizations' success, but rather to document IoE excellence, how public sector entities are putting IoE into practice today, and to inform a roadmap for change that will enable the public sector to address pressing challenges on multiple fronts by drawing on best practices from around the globe.

 

## About the Stockholm Traffic Congestion Charging System

The Stockholm congestion charge is a traffic congestion and environmental tax imposed on vehicles traveling into and out of central Stockholm. Its primary purpose is to reduce traffic congestion and improve the environmental situation in Stockholm. There are 18 congestion charge gates around the city. These gates are barrier-free and do not involve stopping; they register and charge cars using pictures taken by traffic-congestion-charge cameras.

Stockholm also has cameras mounted along city streets to provide journey-time traffic information. This enables the city to track individual and aggregated journeys, allowing for road and public transit planning, as well as real-time traffic management.

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Daniel Firth is the chief strategy officer of the City of Stockholm Traffic Administration. Mr. Firth's education centered on urban planning, and his career has focused on city transport and urban transport planning. He worked on the implementation of London's traffic congestion charging system and its subsequent expansion from 2002 to 2007.

In 2006, Mr. Firth was an informal liaison for Stockholm when it was planning its traffic congestion charge. Shortly after, he accepted a position at the Stockholm City Traffic Administration to implement the congestion tax after a referendum. Mr. Firth now works on a wide range of strategy and planning issues for the city's new urban mobility strategy.

## Objectives

According to Mr. Firth, the idea of a congestion charge started a number of years before the trial took place in 2006. The push came from a combination of city government and the Swedish Parliament, primarily from the Green Party. The main drivers of the discussion were traffic congestion and environmental concerns.

"Stockholm is a city built on a series of islands," Mr. Firth explained. "That means almost any journey you make will cross a bridge at some point. There are a limited number of bridges, so around those bridges there is quite a severe congestion problem. The city is divided in two by the system of waterways between the Baltic Sea and Lake Mälaren to the east, and there are a limited number of ways to go from the north to the south of the city. So, congestion problems at these key bottlenecks – but also an environmental concern, largely around the emission of particulates – drove this in the first place."

A trial was conducted in early 2006, and following public support in a referendum in September 2006, the City of Stockholm adopted the congestion charge permanently, and the congestion tax took effect in 2007.

 

## Strategy

The Stockholm traffic congestion charge was first introduced as a trial between January 3, 2006 and July 31, 2006. Following a referendum in September of that year, it was decided to permanently implement the congestion tax. The referendum took place in the city of Stockholm, as well as in surrounding municipalities. The outlying municipalities did not support the congestion tax, but Stockholm voters passed it, and the incoming coalition government decided to impose the charge.

"We did lots of public attitude surveys, both before and after the trial. Before the trial, attitudes and public opposition were quite overwhelming – around 70 percent were opposed and 30 percent were in favor," Mr. Firth explained. "Almost within weeks of the trial beginning, the relationship switched completely, with maybe 60 to 70 percent in favor and 30 percent opposed. The trial was suspended in the summer of 2006, and there was a referendum in September 2006, together with national elections, asking if they would like to retain the congestion tax. In that referendum, which took place in the city of Stockholm and surrounding municipalities, the majority was 52 percent."

"The media coverage in the days leading up to the congestion tax rollout was focused on the expected chaos. However, a successful rollout led to almost immediate positive media coverage focused on the system's efficiency and positive impact."

Daniel Firth,
Chief Strategy Officer,
City of Stockholm Traffic Administration

The media coverage in the days leading up to the congestion tax rollout was focused on the expected chaos. However, a successful rollout led to almost immediate positive media coverage focused on the system's efficiency and positive impact. Public support quickly followed. "What has happened since the referendum in 2006 and into 2007 is it has become a non-issue," Mr. Firth said. "Now, when we ask people the same question about the congestion tax, the majority is in favor, and a large number have no opinion. It's gone from being a very divisive issue to something that is kind of accepted."

Stockholm provides data to the public so that it can be used for commercial purposes. "What we have is most people using our parking data to try to provide services to help people park," Mr. Firth said. The journey-time traffic data is currently being made available to commercial services such as Google on a webpage called Traffic Now (www.trafiken.nu). "We make all our data available to anyone who wants it. So at the moment, a lot of data is being made available to a lot of researchers. We would like it to be used by anyone who would like to help with journey planning, software applications, mobile phones, that kind of thing. The city council has a policy of making all non-private or commercially sensitive data available to anyone who wants to use it to develop whatever they like."

While initial funding for the congestion charging system was provided by the national government of Sweden, Mr. Firth stated that the system paid for itself in about four years and has since become a helpful addition to the transportation budget. Additional money received is used in various ways to improve public transportation and the local transport infrastructure. The City of Stockholm is currently planning for an increase in the congestion charge by nearly 75 percent in 2016. The maximum charge will increase from approximately US $3 to US $5.50.

 

Because the Swedish courts ruled the charge was not a local charge, but in fact a tax, the project is operated by the National Road Administration. “The city council can only tax citizens; we can’t tax citizens of other municipalities,” Mr. Firth said. “So in order to tax cars that aren’t from Stockholm, we need a tax and that goes through the national Parliament, and therefore it is a national authority that actually is taking the tax.”

Parliament works in concert with the local Stockholm government regarding changes to the congestion charge system. “Because it is affecting our streets, the city council has a very large influence over national Parliament,” Mr. Firth explained. “National Parliament cannot make changes without the city council being in agreement.” The city created an initiative to increase the charge, and the new law was passed by Parliament in late March 2014. The charge increase will take effect on January 1, 2016.

## Solution

The city of Stockholm implemented a congestion charging scheme in inner Stockholm in 2007, following a successful trial in 2006. This scheme utilizes video cameras that take pictures of the license plates of passing automobiles, and then charges a fee to registered users of those automobiles for driving in downtown Stockholm.

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The system is deployed at 18 charging “gates” that ring the inner city. Cars passing through the gates are not required to stop or slow down, and the cameras are triggered by the vehicles’ movements. A vehicle traveling through a charging gate “breaks” a laser beam that triggers a camera to photograph the vehicle’s front license plate. The vehicle then breaks a second laser beam, triggering a second camera that photographs the rear license plate. The plate information is automatically read using Automated Number Plate Recognition (ANPR) software.

Based on the plate reading and the registration information for the vehicle, the vehicle owner is then charged. Charges vary in cost depending on the time of day (higher traffic times = higher charges). Depending on whether the vehicle owner has established an online account, the owner will either have the payment automatically debited from his or her bank account, or will receive a bill. Bills can be paid via the Internet, a bank, or specified retailers.

“The absolute majority of people pay via debit,” Mr. Firth explained. “So in the same way they pay gas bills or rent, they can have a bill sent to them, but mostly it is done by the bank. Everybody has Internet banking; for most payments, you can set up this automatic billing. It’s only occasionally that users are receiving a bill by post and going online and paying it.”

The use of cameras to record passage of vehicles through the charging gates was, according to Mr. Firth, critical from a legal perspective, as tax charges of this sort need photographic proof to hold up in court. “Initially we were using DSRC (RFID) tags,” Mr. Firth says. The city soon changed to a camera capture system — not because the tags didn’t work, but, according to Mr. Firth, “because the cameras in place are much more accurate than anticipated.”

Swedish law dictates that in order to charge the tax, an appeals process must be in place. The DSRC signal for registration was not sufficient, but a picture meets the proof requirements on the government's behalf. According to Mr. Firth, there is an appeal system that allows drivers to check the passages for which they are charged online, so that drivers can verify the accuracy. If a discrepancy is found, the driver can submit an appeal.

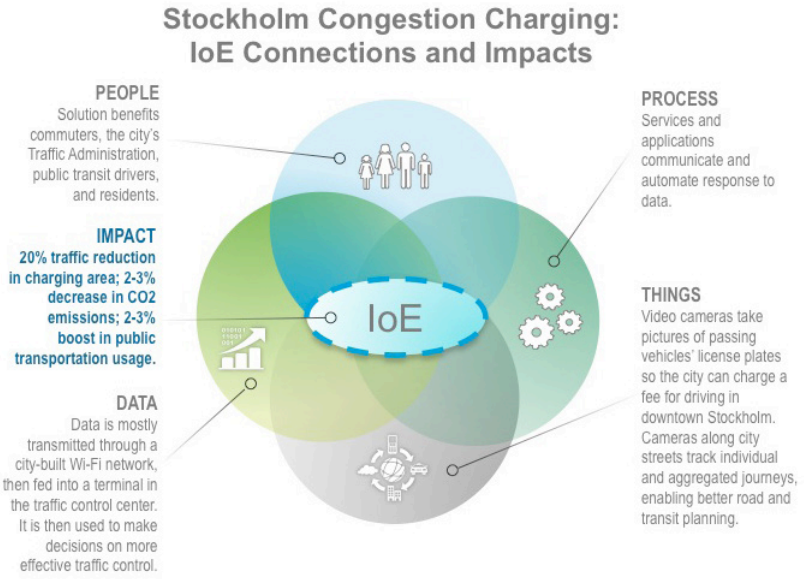
Mr. Firth indicated that because the traffic congestion charge cameras transmit sensitive tax data, the system has a high level of security. The data is transmitted via the city's established fiber network. "It is secure data and needs to have a high level of security and accuracy – it's a closed system," he stated.

Additionally, sensors on public buses track bus location throughout the city .... The system also sends signals to traffic lights so that buses behind schedule are more likely to get a green light.

Mr. Firth indicated that the Stockholm traffic administration maintains a separate system of journey-monitoring cameras that utilize similar license plate detail to calculate how long it is taking vehicles to travel well-established routes across Stockholm. Because a high level of security is unnecessary for data from the journey-time traffic cameras, this data is mostly transmitted through a city-built Wi-Fi network. The data is fed into a terminal in the city traffic control center, where it can be aggregated and used to make decisions on more effective traffic control.

Additionally, sensors on public buses track bus location throughout the city. The bus location data is fed to a central computer via GPS technology. The central control computer then calculates time separation between the buses on a given route and, according to Mr. Firth, sends drivers signals about whether to speed up or slow down, depending on their distance from the bus ahead of them. The system also sends signals to traffic lights so that buses behind schedule are more likely to get a green light. Also, to make the system easier for commuters, bus-location data is fed to each bus stop. The stops have signs communicating when the next bus will arrive, and this information is also made available via mobile phone apps.

**Figure 1.** Stockholm: New and Better Connections.




Source: Cisco Consulting Services, 2014

## Impact

According to Mr. Firth, Stockholm receives unprecedented data from the congestion charge system, and is looking at ways to use the data to provide better, more efficient services. Through its journey-time monitoring system, the Traffic Administration uses cameras to trace vehicles as they pass through the system to see how many through trips are made, which entrances and exits are most utilized, and how long people drive each day.

The data also allows the city to more effectively program traffic signals for traffic flows – both in long-term planning and real-time response. "It's maybe adjusting on a weekly or monthly basis," Mr. Firth says. "Then there is data that is being input into the traffic control center, which then is able to implement a certain traffic signal plan, for example. So if something happened and we see a burden, or there has been an accident, it allows operators on the traffic control system to implement a standard plan such as closing tunnels or closing lanes, or changing speed limits or traffic signal time to cope with that disturbance."

Stockholm has also benefited by having less traffic and increased public transit use – including a 20 percent reduction in traffic within the congestion charge area.

Stockholm has also benefited by having less traffic and increased public transit use – including a 20 percent reduction in traffic within the congestion charge area. "The 20 percent depends on the direction you are looking and the time of day," said Mr. Firth. "So it is between a 20 and 40 percent reduction in journey-time delays, or the measure of congestion that we use. It's not just locally – it's up to maybe 10 kilometers from the congestion tax zone where we are also seeing a reduction in traffic. [This means there has been] no traffic growth, despite very rapid population growth [by nearly 100,000 people since 2006]."

The environment of the city has seen improvement as well. "Carbon dioxide emissions are down 2 to 3 percent and counting," Mr. Firth said. "It sounds like a small number, but for a single measure, it is quite substantial." He added that there has also been a 10 to 15 percent reduction in PM10-level particulates within the city.

The city has also seen a 2 to 3 percent increase in public transportation use since the introduction of the traffic congestion charge.

## Lessons Learned / Next Steps

According to Mr. Firth, cooperation between the public and commercial (technology) entities was a key to a smooth rollout of the traffic congestion charge system. "One of the most important lessons learned is that the technology we used was well-tested. We knew it was going to work, and it worked very well from day one and has continued to work. A lot of the reason for that has been very close cooperation between public authorities and the commercial partners who are involved. I can't really stress that enough, how important that was."

Extensive planning and modeling of the system itself was another important lesson. "First, we had really done our homework in terms of modeling the traffic system and what we thought would happen," Mr. Firth explained. "A lot of time went into both developing and refining traffic models and using them to really understand

what the impact would be. You can't introduce this kind of system just by thinking about it or using the experience of traffic engineers, you need to use these models to understand what the effects are. Traffic is like water: it will make its way through unless you know what you are doing, and you need to really understand what the impact is."

This planning led to nearly immediate public approval of the project. "It was a 20 percent reduction in traffic, and you could see it; you didn't need to see the data in nice graphs that we pumped out – you could see it with your own eyes. I think the reason public opinion changed so quickly is that what happened was exactly what we promised would happen, and being able to see that was a very significant part. It's a big change, so the communication around it – explaining that you are trying to make the traffic system work better and that you are trying to improve the city environment – was very important."

According to Mr. Firth, Stockholm will increase the congestion charge in 2016, which modeling indicates will further decrease traffic by 7 to 10 percent.

According to Mr. Firth, Stockholm will increase the congestion charge in 2016, which modeling indicates will further decrease traffic by 7 to 10 percent. "At the moment, the maximum charge in the middle of rush hour is 20 Swedish kroner per passage, which we would increase to 35 Swedish kroner," he said. Mr. Firth says the traffic reductions "will give us more opportunities to bring improvements to the urban environment and to reduce emissions."

One way Stockholm hopes to do this is by using data gathered by the congestion charge system and journey-time cameras, paired with weather and accident data from the past seven or eight years, to make short-term predictions about traffic to stop potential problems before they occur. "We are in the process of trying to use this data and lots of other data and methods for very short-term predictions on what is happening in the traffic system. Instead of waiting until an incident happens and then implementing our traffic management systems, we can force-feed these problems before they happen and start using management tools – the traffic signals, message signs, and such – to make sure the problem doesn't occur, or to reduce the impact of the problem."

Stockholm hopes that individuals or organizations will use the data from the journey-mapping system to develop better travel plans for individuals. "We are opening our data so that people who are much better with this type of thing than the public authority can run these things," Mr.Firth stated.

Separately from the traffic congestion charge, Stockholm wants to implement a parking services program that would assist commuters via a mobile application.

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