"An Introduction to the Internet of Things (IoT)"

Part 1. of "The IoT Series"

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What Is The Internet of Things (IoT)

The Internet of Things may be a hot topic in the industry but it's not a new concept. In the early 2000's, Kevin Ashton was laying the groundwork for what would become the Internet of Things (IoT) at MIT's AutoID lab. Ashton was one of the pioneers who conceived this notion as he searched for ways that Proctor & Gamble could improve its business by linking RFID information to the Internet. The concept was simple but powerful. If all objects in daily life were equipped with identifiers and wireless connectivity, these objects could be communicate with each other and be managed by computers. In a 1999 article for the RFID Journal Ashton wrote:

> *"If we had computers that knew everything there was to know about things—using data they gathered without any help from us -- we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best. We need to empower computers with their own means of gathering information, so they can see, hear and smell the world for themselves, in all its random glory. RFID and sensor technology enable computers to observe, identify and understand the world—without the limitations of human-entered data."[1]*

At the time, this vision required major technology improvements. After all, how would we connect everything on the planet? What type of wireless communications could be built into devices? What changes would need to be made to the existing Internet infrastructure to support billions of new devices communicating? What would power these devices? What must be developed to make the solutions cost effective? There were more questions than answers to the IoT concepts in 1999.

Today, many of these obstacles have been solved. The size and cost of wireless radios has dropped tremendously. IPv6 allows us to assign a communications address to billions of devices. Electronics companies are building Wi-Fi and cellular wireless connectivity into a wide range of devices. ABI Research estimates over five billion wireless chips will ship in 2013.[2] Mobile data coverage has improved significantly with many networks offering broadband speeds. While not perfect, battery technology has improved and solar recharging has been built into numerous devices. There will be billions of objects connecting to the network with the next several years. For example,Cisco's Internet of Things Group (IOTG) predicts there will be over 50 billion connected devices by 2020.[3]

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[1] http://kevinjashton.com/2009/06/22/the-internet-of-things/

[2] https://www.abiresearch.com/press/over-5-billion-wireless-connectivity-chips-will-sh

[3]http://www.cisco.com/web/about/ac79/docs/innov/IoT_IBSG_0411FINAL.pdf

IoT describes a system where items in the physical world, and sensors within or attached to these items, are connected to the Internet via wireless and wired Internet connections. These sensors can use various types of local area connections such as RFID, NFC, Wi-Fi, Bluetooth, and Zigbee. Sensors can also have wide area connectivity such as GSM, GPRS, 3G, and LTE. The Internet of Things will:

- **Connect both inanimate and living things.** Early trials and deployments of Internet of Things networks began with connecting industrial equipment. Today, the vision of IoT has expanded to connect everything from industrial equipment to everyday objects. The types of items range from gas turbines to automobiles to utility meters. It can also include living organisms such as plants, farm animals and people. For example, the Cow Tracking Project in Essex uses data collected from radio positioning tags to monitor cows for illness and track behavior in the herd. Wearable computing and digital health devices, such as Nike+ Fuel band and Fitbit, are examples of how people are connecting in the Internet of Things landscape. Cisco has expanded the definition of IoT to the Internet of Everything (IoE), which includes people, places, objects and things. Basically anything you can attach a sensor and connectivity to can participate in the new connected ecosystems.

- **Use sensors for data collection.** The physical objects that are being connected will possess one or more sensors. Each sensor will monitor a specific condition such as location, vibration, motion and temperature. In IoT, these sensors will connect to each other and to systems that can understand or present information from the sensor's data feeds. These sensors will provide new information to a company's systems and to people.

- **Change what types of item communicate over an IP Network.** In the past, people communicated with people and with machines. Imagine if all of your equipment had the ability to communicate. What would it tell you? IoT-enabled objects will share information about their condition and the surrounding environment with people, software systems and other machines. This information can be shared in real-time or collected and shared at defined intervals. Going forward, everything will have a digital identity and connectivity, which means you can identify, track and communicate with objects.

IoT data differs from traditional computing. The data can be small in size and frequent in transmission. The number of devices, or nodes, that are connecting to the network are also greater in IoT than in traditional PC computing. Machine-to-Machine communications and intelligence drawn from the devices and the network will allow businesses to automate certain basic tasks without depending on central or cloud based applications and services.These attributes present opportunities to collect a wide range of data but also provide challenges in terms of designing the appropriate data networking and security.

What It Means For Your Business?

IoT impacts every business. Mobile and the Internet of Things will change the types of devices that connect into a company's systems. These newly connected devices will produce new types of data. The Internet of Things will help a business gain efficiencies, harness intelligence from a wide range of equipment, improve operations and increase customer satisfaction. IoT will also have a profound impact on people's lives. It will improve public safety, transportation and healthcare with better information and faster communications of this information. While there are many ways that the Internet of Things could impact society and business, there are at least three major benefits of IOT that will impact every business, which include: communication, control and cost savings.

The Three Cs of IoT

Communication. IoT communicates information to people and systems, such as state and health of equipment (e.g.it's on or off, charged, full or empty) and data from sensors that can monitor a person's vital signs. In most cases, we didn't have access to this information before or it was collected manually and infrequently. For example, an IOT-enabled HVAC system can report if its air filter is clean and functioning properly. Almost every company has a class of assets it could track. GPS-enabled assets can communicate their current location and movement. Location is important for items that move, such as trucks, but it's also applicable for locating items and people within an organization. In the healthcare industry, IoT can help a hospital track the location of everything from wheelchairs to cardiac defibrillators to surgeons. In the transportation industry, a business can deliver real-time tracking and condition of parcels and pallets. For example, Maersk can use sensors to track the location of a refrigerated shipping container and its current temperature.

Control and Automation. In a connected world, a business will have visibility into a device's condition. In many cases, a business or consumer will also be able to remotely control a device. For example, a business can remotely turn on or shut down a specific piece of equipment or adjust the temperature in a climate-controlled environment. Meanwhile, a consumer can use IoT to unlock their car or start the washing machine. Once a performance baseline has been established, a process can send alerts for anomalies and possibly deliver an automated response. For example, if the brake pads on a truck are about to fail, it can prompt the company to take the vehicle out of service and automatically schedule maintenance.

Cost Savings. Many companies will adopt IoT to save money. Measurement provides actual performance data and equipment health, instead of just estimates. Businesses, particularly industrial companies, lose money when equipment fails. With new sensor information, IoT can help a company save money by minimizing equipment failure and allowing the business to perform planned maintenance. Sensors can also measuring items, such as driving behavior and speed, to reduce fuel expense and wear and tear on consumables. New smart meters in homes and businesses can also provide data that helps people understand energy consumption and opportunities for cost savings.

How To Get Started

These are just a few examples of how IoT can help a business save money, automate processes and gain new insight into the business. To reap the benefits IoT can provide, a business should address at least the following four items:

1. **Define what you'd like to learn from sensors.** Over the next three years, a majority of the devices purchased will have sensors and many existing items can be retrofitted with sensors. This will produce a wide range of new data sources for people and systems to use to improve their lives and existing business processes. Within a business setting, IT must define what types of information can be obtained from these sensors and work with business leaders to define which business processes can be improved with this new IoT information. For example, sensor data that highlights anomalies in equipment vibration can be used to predict and avoid equipment failure.

2. **Build an IOT network and security foundation.** Many industrial IoT deployments have used proprietary networks. Instead of building proprietary networks, IT should connect IoT devices with standards-based IP networks. An IP-based network will help businesses deliver the performance, reliability and interoperability that are required to support global IoT networks and connections with partner ecosystems. Additionally, many businesses are focused on building security strategies for smartphones and tablets, but this is just one aspect of the new mobile world. The proliferation of connected sensors and equipment provides new security concerns. As IT embraces IoT, it needs to ensure it has built safeguards into the solution including security procedures such as hardware encryption, physical building security and network security for data in transit. Identity and authentication structures will also need to be updated to support "things" as well as people.

3. **Collect as much data as possible.** Businesses that don't plan carefully for IoT will be overwhelmed with the volume and variety of data that IoT will generate. While each sensor may only produce a small amount of data, a company will be collecting data from thousands to millions of sensors. Firms must

build a data collection and analytics strategy that supports this new torrent of information in a scalable and cost effective manner. Big data technology, such as Hadoop and NoSQL, can give companies the ability to rapidly collect, store and analyze large volumes of disparate IoT data. A company should collect any data that is relevant to existing processes. If possible and cost-effective, a company should also collect additional data that will enable the business to answer new questions in the future.

4. **Review the size and scale of IoT providers.** IoT is a complicated landscape with numerous categories and many vendors within each category. The four main categories of an IoT solution are: a sensor(s) and radio(s) that often sits in the machine, a M2M device-management platform, a solution delivery platform and apps that enable IoT devices to report or act on data. While there are many vendors, no single vendor offers a complete solution without building partnerships. As a firm begins its IoT voyage, IT and line of business executives should build a cross-functional team to evaluate strategic partners. The team should evaluate the financial position of the vendors, industry knowledge, partnerships and breadth of offerings.

About Lopez Research

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