White Paper

Solutions for Communications Interoperability

Communications interoperability and collaboration between different agencies, organizations, or departments are a serious challenge for many markets segments including enterprise safety and security, transportation, retail, financial and, of course, public safety and defense. Interoperability simply refers to the ability of personnel to communicate with staff from other agencies and organizations across different networks and devices. Communications interoperability focuses initially on solving the radio interoperability issue between different organizations or agencies which are often hampered by competing and conflicting business interests, organizational dynamics, public safety needs, the regulatory environment, and funding limitations.

Various approaches to interoperability are available. This paper examines interoperability with the perspective that although voice interoperability addresses today's key tactical needs, any proposed solution should provide a graceful migration to future strategic requirements for integrated voice, video, and data interoperability as well. Also this document is designed to help both policy and technical decision makers plan for and implement effective interoperable communications systems by examining the current interoperability environment of radio networks, discussing the transformation of voice to IP networks, and making the case as to why standards-based IP technology is the foundation to solving all future interoperability issues. Communications interoperability based on a network solution should be the foundation for all future interoperability solutions, and organizations and customers who plan accordingly will fulfill current tactical requirements as well as lay the basis for addressing future strategic needs.

CHALLENGE: RADIO INTEROPERABILITY

Many citizens wrongly assume that different emergency response organizations can communicate with each other. The following matrix (Table 1) provides a useful example of the environment using a "typical city" in the United States. While this is a classical description that could apply to many cities, customers in enterprise safety and security, financial, transportation, retail, and other markets also regularly use different and incompatible voice communications systems (such as handheld radios, "hoot-and-holler" systems, phones systems, etc.) and as such face similar interoperability and collaboration issues.

Table 1. Communication Systems in a Typical Metropolitan City

Networks	FEMA	FBI	Military	National Guard	State EMS	State Police Dept	City Fire Dept and EMS	City Police Dept
VHF Radios	X	X			X	X	X	
UHF Radios			X					
Other	X	X	X	X				
800 MHz P25 System					X	X		
800 MHz Non-P25 System								X

From this capabilities matrix, several specific concerns are apparent, including:

- Organizations use systems on different frequency bands (such as VHF versus UHF) that cannot talk to each other
- Two systems that operate in the same frequency band yet do not talk to each other because they use different underlying radio technology
- The very real concern that the number of agencies, organizations, and voice communications systems involved will most likely grow in number over time

There are various underlying reasons, both technical and nontechnical, for this lack of interoperability including organizational influence, policies, funding, and spectrum allocation. For example, according to a U.S. government Web page, there are more than 20,000 fire departments and approximately 100,000 federal law enforcement agents. In addition, these entities are autonomous in their budgets and their planning and purchasing of communications systems. Policies allow these entities to operate as the most knowledgeable stewards of their assigned missions, and each will set their own courses for communications systems. Understandably, interoperability has been an expensive task given the significant investments in older systems and training. Funding limitations is often an issue especially at the local levels where interoperability ironically may be most needed. In enterprise safety and security, financial, and transportation, customers have older systems that sustain critical business communications and operations. Finally, radio spectrum allocation has been an issue because spectrum is a truly scarce commodity that is allocated by government entities.

POTENTIAL INTEROPERABILITY SOLUTIONS

There are three general approaches to achieving interoperability: using the same radios systems, using gateway devices, or using IP networks. When discussing the merits of each approach, considerations include whether it protects the significant investment in older systems. Also, does the approach accommodate day-to-day operations and can it transform dynamically for emergencies? Does the approach take advantage of standards-based Internet Protocol? Finally, does the proposal accommodate future integration of video, data, etc?

Of note, options such as console patching, mutual aid channels, and collocated radio devices are deemed unacceptable because they do not scale well, nor can they dynamically accommodate additional agencies—fundamental requirements for interoperability during a crisis.

Option 1: Using the Same Radios or Communications Systems

The ideal solution is for all organizations and agencies to use the same communications equipment. However, this is not feasible. Enterprise customers conduct business-critical voice communications on traditional communications systems. Large-scale replacement of these systems is disruptive, impractical, and economically unrealistic as well.

For public safety, a common radio communications system in the local, state, and federal governments would cost approximately US$20-$40 billion, according to many industry estimates. Additionally, the time to complete an infrastructure replacement and installation would be 20 years or so. Third, the cost that local governments or agencies would bear is simply untenable. This would include the cost of a new large-scale infrastructure build out as well as the significant investment in the older radio network applications and training. These radio systems typically have a life cycle of 15 to 20 years and in some cases they have only very recently been deployed.

A final concern is that of spectrum or radio frequency allocation and usage. Spectrum is a precious resource that is scarce and highly controlled. As frequencies become scarce and crowded, the search for additional spectrum continues. The very process of allocating radio spectrum can take years of processing by government regulatory agencies before businesses can begin the task of developing products. Clearly there are many spectrum and use issues to be managed, but communications interoperability cannot be achieved through a regulatory solution. Technology, when properly implemented, will continue to be the most effective tool to address interoperability.

Option 2: Gateway Devices

To facilitate communications and collaboration between different agencies and organizations today, local governments, municipalities, and counties often have reciprocal agreements and policies to exchange or provide handheld radios to each other. This multiple radio installation is useful in the local area, but is not feasible statewide because the number of different radio systems is simply too large. Further, adding more than two or three radio systems becomes extremely cumbersome—and sometimes dangerous because of distraction or missing information.

Understandably, gateway devices are popular and exist to provide limited interoperability between two otherwise incompatible systems. But they should be considered as tactical, interim solutions. This approach is expensive, does not scale well as the number of radio systems increases, and if improperly managed could lead to disastrous results. Radio gateways are best used in a locally focused and limited tactical role to ease interoperability issues in the short term. Moreover, those systems do not provide a means to dynamically respond and adapt to ad hoc events and emergencies. The emergence of a converged voice, video, and data IP network will render these gateways obsolete.

Option 3: Radio Interoperability Using IP

The converged network of the future is an intelligent IP network that provides a common transport for all types of communications services. Adopting an IP network-based interoperability solution for push-to-talk, Land Mobile Radios (LMRs), and hoot-and-holler systems provides many attractive benefits. There is tremendous value in connecting these existing disparate networks and thereby extending geographic radio coverage.

The superior method of linking networks is through the use of a mechanism that connects communications paths together so that people can talk together without being permanently connected. This provides a dynamic response to events, and allows virtually limitless expansion of the network as needed, without costly upgrades. An IP network-based solution is independent of the underlying (radio) technology or equipment vendor. Notably, this approach provides for communications interoperability that is several orders of magnitude cheaper than replacing entire radio systems. And an IP network solution can be implemented on a geographically broad scale for a fraction of the cost of any other similar interoperability solutions.

Moreover, an IP network-based solution allows for dynamic linking of networks, organizations, and users on a case-by-case or emergency-by-emergency basis, a fundamental requirement for interoperability during a crisis. It also provides an immediate interoperability solution during the transition period between older networks and the implementation of new networks and technologies. While presenting an immediate tactical solution to voice interoperability, this IP network-based solution can provide for communications interoperability well into the future. In short, IP network-based communications interoperability offers a solution that will also be viable in the future as new networks, technologies, and requirements evolve.

IP NETWORK-BASED INTEROPERABILITY

IP network-based communications interoperability best addresses customer requirements for resiliency, reliability, and investment protection with a graceful migration to future strategic interoperability requirements. Such a solution also provides for dynamic morphing from day-to-day operations to addressing agency communications needs during emergencies.

Resiliency and Reliability

Achieving reliability across a network is a combination of careful network design and practices. A well-designed IP network does not have single points of failure. An interoperability solution should eliminate communications silos and single points of failure and offer a resilient, redundant, and network-enabled solution based on IP standards. Any solution should be rapidly deployable to meet demanding requirements for information sharing between agencies. These points are especially critical for public safety networks.

Converged Networks

Converging voice and data networks provides many benefits. Bridging push-to-talk (PTT), hoot-and-holler, and radio networks to the IP network extends radio reachability to IP reachability, and protects the investment in existing technology. Other benefits include cost savings from using the existing networks and a common IP infrastructure, bringing new rich IP features, and establishing a platform for integrating future media types and information.

Investment Protection

Some markets such as financial have existing deployments of push to talk based systems (e.g. hoot-and-holler audio systems) and make significant investments including maintenance. These older systems support critical business voice communications for various offices and organizations. Similarly LMR radio systems typically have very long life spans of between 10 and 25 years. Considering the sizable investment in radio interoperability at all levels of government, no agency wants to make the wrong choice. The ability to implement new services and features along with preserving older systems is an important requirement to any interoperability strategy.

Given this information, it is clear that communications interoperability using IP network-based solutions provides the greatest value and the most effective interoperability solution available today. Using an IP network-based solution, interoperability can be achieved across all these organizations and systems.

CONCLUSION

Interoperable communications are critical to customers in enterprise operations, finance, public safety, and other markets. There are many factors affecting interoperability, including technical challenges with current solutions and nontechnical issues such as policies, inadequate funding, and spectrum allocation. Public safety agencies are using technology to meet their interoperability requirements. However, selecting the right solution or technology is difficult. While there are several available low-tech solutions to achieving interoperability, most do not scale for large deployments and cannot dynamically accommodate additional agencies during a crisis. Adopting new radio standards or replacing all existing radios with all new radios to achieve interoperability is a costly and unrealistic solution. IP networking provides the most viable solution to communications interoperability. It is critical that any selected interoperability solution is flexible and modular to incorporate new technologies as well as guarantee investment protection. As new technologies emerge, interoperability should be integrated through upgrades. The challenge of interoperability requires a world-class architecture that supports strategic future needs for integration. In this process, radio interoperability is understood to be a subset of communications interoperability.

Cisco® IP Interoperability and Collaboration System (IPICS) is the industry leading intelligent network based system that integrates disparate PTT radio systems together with other voice, video, and data networks. It quickly and easily facilitates collaboration across multiple network, operational, or organizational domains on an as-needed basis. Based on proven IP standards, Cisco IPICS delivers a flexible, dynamic, and secure communications interoperability and application platform for real-time information sharing, improving daily enterprise operations as well as emergency safety and security management. The Cisco IPICS vision is to deliver the right information to the right person in the right format at the right time.

The Cisco IPICS system software is the cornerstone of the complete Cisco IPICS system and includes the Incident Management Application, Policy Engine, database information, authentication and security services, user management, and other back-end functions. It also provides centralized management of the network resources and control plane functions to establish the interoperability needs for a given incident or operations event. Additionally, the IPICS PMC client, which supports up to eight simultaneous radio channels or virtual talk groups, provides push-to-talk functionality on the desktop to communicate with legacy radio or hoot and holler networks. The Cisco IPICS Push-to-Talk Management (PMC) client application is a critical component in achieving the Cisco IPICS vision for comprehensive voice interoperability.

Enterprise operations as well as security and emergency management personnel will use Cisco IPICS for real-time information sharing and effective operations management using an intuitive and adaptive user interface. Cisco IPICS release 1.0 is focused on comprehensive voice interoperability as the first critical step while laying the foundation for future integration of data, sensor, video, and other systems.

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