2007 NASCIO Award Submission
Information Communications Technology Innovations

Pennsylvania Statewide Radio Network: PA-STARNet
Inventing the future of public safety communication

Executive Summary

In the mid-1990s, the Commonwealth of Pennsylvania faced the prospect of replacing an aging analog radio system used by Pennsylvania State Police for statewide dispatch and patrol, along with others operated by agencies such as the Department of Conservation and Natural Resources, the Department of Transportation, the Office of Attorney General, and the Capitol Police Department. All of these systems were separately purchased, deployed, operated, and maintained, using different technologies and portions of the frequency spectrum, with limited ability to intercommunicate.

At that point, the Commonwealth made a number of key decisions:

- Rather than replacing these systems one-by-one and allowing them to remain under agency control, it decided to deploy a single system comprising transmitters and receivers across the state, connected and managed centrally through a microwave network.
- It stipulated that the new system would support both voice and data communications, freely intermingled.
- It placed responsibility for design, development, operation, and support of the new system in an office dedicated to that purpose, charged with delivering wireless voice and data services to the benefit of all agencies of Commonwealth government requiring them.

Through an intensive, detailed, and rigorous competitive procurement process, the Commonwealth selected an innovative, leading-edge digital technology, enormously promising in range and flexibility of services, features, and functions, but largely undeveloped and unproved. In its emerging partnership with M/A-COM, Inc., the awarded technology supplier, the Commonwealth has served as a test bed to shepherd the development of a new generation of public safety communications technology.

Development and implementation of this technology for application to the Commonwealth's wireless voice and data communications requirements is the most complex and costly information technology project ever attempted by the Commonwealth. Its result is the new radio system now known as the Pennsylvania Statewide Radio Network, PA-STARNet. Together with M/A-COM, Pennsylvania is truly inventing the future of public safety communication.

The original scope of effort was to provide the various agencies of Commonwealth government with a single radio platform. That scope expanded dramatically after the September 11th attacks. The heightened awareness of threats to our security and the actions necessary to respond to them introduced a new requirement for PA-STARNet: interoperable communication among state resources and county and municipal first responders. This is a goal the Commonwealth is pursuing vigorously.

Description of the System

Background

PA-STARNet provides wireless digital voice and data communication services across the Commonwealth using the 800 megahertz (MHz) frequency band designated for public safety use. System design and development began in 1996 with Pennsylvania Legislative Act 148, with the original objective of replacing incompatible, aging radio systems in Commonwealth government with a single centrally managed statewide system supporting both voice and data communications. As planning, design, and deployment evolved, especially following the 9/11 attacks, the scope of system development expanded significantly to include creating a framework for interoperable communication that encompasses county and local emergency responders.

System technology

PA-STARNet uses trunked digital multicast technology from M/A-COM, Inc., a unit of Tyco Electronics Corporation. M/A-COM's OpenSky® system makes use of both high-profile multichannel base station sites and low-profile compact microcell sites connected through a microwave backbone to implement a highly efficient packet switching communications network, freely mixing voice and data traffic, based on Time Division Multiple Access (TDMA). The system incorporates standard components such as Internet Protocol (IP), Cellular Digital Packet Data (CDPD), and off-the-shelf workstations, routers, and database software.

The system incorporates a high degree of redundancy for high availability. High-profile sites have backup electrical power sources and are largely independent of commercial communications services. There are dual points of entry to the network, protected by a firewall, located remotely from each other. Both the geographic dispersion of system infrastructure and the ability of components to operate independently help ensure availability and survivability.

Current status

With system software certified as "public safety ready" in September 2003, PA-STARNet formally entered the operational phase as deployment of infrastructure to extend coverage continued. Today there are more than 12,000 subscriber devices authorized to use the system with as many as 3,000 users actually connected at a given time, initiating some 40,000 transmissions daily. PA-STARNet is one of the largest public safety communications systems in North America, with one of the largest privately constructed microwave networks in the world. RF coverage currently extends over 90% of the Commonwealth's 45,000 square miles.

Approximately 20 Commonwealth agencies use PA-STARNet or are in some stage of planning for its use, along with business partners and various public safety organizations in counties and municipalities, including nine Regional Counter-Terrorism Task Forces, participating under Commonwealth agency sponsorship. Following are some examples of use:

- Having used the network for mobile data terminals since 2002, with transaction levels from vehicle and criminal inquiries reaching 2.7 million in February 2007, Pennsylvania State Police began primary voice communication use in selected locations in Spring 2006.
- The Department of Health has deployed more than 280 fixed-location radios in hospitals and other medical facilities across Pennsylvania to provide wireless backup and redundancy for its Health Alert Network.
- The Department of Transportation uses some 4,800 mobile, hand-held, and fixed-station radios to coordinate highway maintenance and snow removal operations.

PA-STARNet has proved its effectiveness during a number of recent incidents, including the following:

- Emergency communication during the response to severe flooding in northeastern Pennsylvania in June 2006;
- Tactical communications support for PSP units at the Nickel Mines Amish school shootings in October 2006; and
- Coordination of resources across multiple agencies during the snow emergency of February 2007.

Business Problem and Solution

Following the vision of the original architects of PA-STARNet, building on M/A-COM's visionary OpenSky technology, has proved a wise direction. The objectives set forth for the statewide system more than ten years ago remain compelling, and the system design and technology have been sufficiently robust to accommodate the project's expanded scope and objectives since its initiation.

Need for statewide mobile communications infrastructure

Pennsylvania is a large state with highly varying terrain and density of population, ranging from the metropolitan areas of Philadelphia and Pittsburgh to the mountainous terrain and sparse population of the northern counties. Agencies with statewide service responsibility require both an extended network of facilities and a high degree of mobility to carry out their business missions, in turn requiring reliable and effective statewide communication to control and coordinate resources.

PA-STARNet provides a platform to satisfy these requirements, for data applications as well as for voice. The network extends over rural and lightly populated areas in which commercial communications services are spotty and unreliable. Beyond the circle of state government alone, PA-STARNet supports interoperable communication for coordination of resources among all levels of government.

Aging, disparate legacy radio systems

The original motivation for development of PA-STARNet was the realization that the variety of agency radio systems existing at the time were not only largely incompatible, but also aging and increasingly expensive to operate and maintain. Rather than funding replacement of these systems separately, the Commonwealth elected to consolidate, placing responsibility for a common system in a new office under the Governor's Executive Offices in the Office of Administration. The Office of Public Safety Radio Services is charged with providing reliable, efficient, and highly available mobile voice and data communications services to all Commonwealth agencies, under a governance structure that gives all stakeholders a voice in decision-making and policy development.

Duplication of resources, infrastructure, and effort

In consolidating the delivery of wireless voice and data services, the Commonwealth eliminated much of the duplication of investment, effort, and infrastructure for maintaining separate radio systems. Centralized management and administration brings dedicated resources to the problems of development, operation, and support previously spread among several agencies, freeing them to concentrate on their core business missions.

Lack of interoperable communication

By replacing separate agency systems using different technologies and portions of the frequency spectrum with a single statewide system, the Commonwealth provides a common platform not just for interagency

communication but also for interoperability with external radio systems. The Commonwealth's approach to interoperability makes each of its 911 centers a point of entry to county and municipal responders and public safety entities. All 67 of the Commonwealth's counties already have basic connections with PA-STARNet. Further efforts focus on developing a statewide plan to enrich communications capabilities and establish statewide policies and procedures ensuring effective intercommunication. An Interoperability Summit in June 2007 marks a key step toward collaborative development of a rich and effective plan.

Adoption of M/A-COM's NetworkFirst® technology has been a key component of the interoperability strategy. NetworkFirst is an IP-based networking solution that complements PA-STARNet's OpenSky technology by providing a means to connect external radio systems, regardless of brand, frequency band, or operating mode.

Scarcity of available frequency spectrum

With mounting competition from various technologies for a place on the frequency spectrum, the regulatory environment demands that wireless communications systems use RF resources much more efficiently than conventional legacy radio systems do. PA-STARNet conserves frequency use in three ways:

- It consolidates the requirements of separate agency systems.
- Through focused planning and design made possible by consolidation, it promotes the reuse of frequencies across the Commonwealth.
- It uses TDMA to compress and interleave voice and data packets, yielding enormous economy compared with the dedicated channel use characteristic of legacy analog systems.

Plans to migrate infrastructure in densely populated areas to four-slot TDMA will yield further economy by doubling the efficiency of channel use.

Significance to the Improvement of the Operation of Government

While achievement of PA-STARNet's coverage targets to complete the system requires significant additional development, the system has already had visible and notable impact on the operation of Commonwealth government in a number of areas.

Ability to communicate statewide

Communications systems like PA-STARNet exist to enable control and coordination of organizational functions over a wide area through the exchange of information. Accordingly, the principal measure of the system's improvement of the operation of government is its contribution to better communication and, in turn, better control and coordination of significant Commonwealth business processes. These range across law enforcement, state park and forest operations, correctional institution security and prisoner transport, radiation protection and nuclear incident response, health organization coordination, National Guard operations, roadway maintenance and snow removal, and motor carrier enforcement.

The common communications platform PA-STARNet affords for interagency communication offers great potential for gains in operational efficiency and effectiveness. For instance, highway incidents such as a tractor trailer spill can easily engage multiple agencies including State Police, Transportation, Environmental Protection, and Agriculture. In these cases, a common tool for communication and coordination is a strategic aid to effective, efficient use of Commonwealth resources, focusing response activities where they are most needed and reducing confusion and uncertainty. In addition, routine use for interagency communication and cooperation promotes a strategic, enterprise-level view of Commonwealth government operations and use of assets.

Centralized management and administration of development, operation, and support

Maintaining and operating separate radio systems for individual agencies entails duplication of resources, assets, and business functions, creating a significant drain on limited resources and a distraction from agencies' core business missions. By consolidating wireless communications responsibility in a central, dedicated organizational unit, PA-STARNet frees agency resources and allows them to return focus to their primary service delivery missions. Recipients benefit in improved service.

Improved financial responsibility and accountability

A single network with a single organizational entity responsible for development, operation, and support encourages and facilitates an enterprise view for budgetary planning and tracking. The increased transparency of the conduct of Commonwealth government promotes responsiveness and accountability, a general benefit both to agencies in guiding service delivery toward better alignment with citizens' needs, and again, ultimately to the service recipients themselves.

Financial leverage and cost savings from consolidation and aggregation

Consolidation also makes possible greater leverage in negotiating prices for services, equipment, and software. For instance, the negotiated purchase of over $26 million of subscriber equipment based on aggregated agency demand saved more than $5 million compared with prevailing contract pricing. Agencies receiving this equipment benefit from the relief of demand on their equipment budgets, and taxpayers benefit from the reduction in cost.

Realized Return on Investment

As development of PA-STARNet and agency transition to its use continue, the full impact of system deployment on the operation of Pennsylvania government has yet to be realized. Because of this, a full assessment of return on investment is an exercise that awaits completion of development and transition of agencies to use of the new system. System completion, satisfying county coverage targets across the state for contract compliance and providing a satisfactory level of support for agency operations, is currently projected to occur by the end of 2008. A target date for completion of agency transition, which is subject to agency plans and allocation of resources and complicated by issues like the rebanding of public safety systems operating in the 800 MHz band, is much more difficult to project.

Quantifying return on investment for a complex strategic asset such as PA-STARNet is a daunting effort in any event. To date, funding appropriated for development and operation of the system is $311 million. This amount excludes agency subscriber equipment and other expenditures related to agency transition to use of PA-STARNet, which appear in the budgets of agencies using the system. For roughly the same cost as replacing the aging Pennsylvania State Police legacy radio system alone, the Commonwealth now has a statewide wireless land mobile radio system serving the requirements of all agencies, supporting intermingled voice and data traffic. It operates with high availability, and its infrastructure is decentralized and highly survivable. Application of this resource is entirely responsive to Commonwealth requirements and priorities.

Specific cost savings, increasing return on investment in PA-STARNet, have come from the application of consolidated buying power, as in the $26 million aggregated subscriber equipment purchase. The system also saves costs by providing voice and data services that would otherwise require commercial service contracts. Finally, as agencies make the transition to use of PA-STARNet, reuse of legacy system assets such as frequency licenses and infrastructure will further increase PA-STARNet's return on investment.