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## **Pennsylvania STARNet**

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2010 NASCIO Awards  
Information Communications Technology Innovation  
Commonwealth of Pennsylvania

## 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 (PSP) for statewide dispatch and patrol. Other agencies also used a variety of separately purchased, deployed, operated, and maintained analog radio systems, using different technologies with limited ability to interconnect.

After much study, the commonwealth made the following key decisions:

- Rather than replace existing systems one-by-one and allow them to remain under agency control, the commonwealth would deploy a single system with transmitters and receivers statewide, connected and managed centrally through a microwave network.
- The new system would support both voice and data communications, freely intermingled, using Voice over Internet Protocol (VoIP) technology.
  - VoIP is the digital transmission of voice communications through a data network based on Internet Protocol (IP).
  - VoIP and IP routing technologies allow voice and data communications to share networks and thus increase spectral efficiency and reliability.
  - VoIP technologies encode and route digitized voice and data traffic over the commonwealth's IP networks – both wireless and private Wide Area Networks (WAN).
- The design, development, operation and support of the new system would be the responsibility of a single office dedicated to that purpose, charged with delivering wireless voice and data services to benefit all commonwealth agencies.

The commonwealth selected an innovative, leading-edge digital technology. It was enormously promising in range and flexibility of services, features, and functions—but untested and unproven.

In September 2003, the Pennsylvania statewide radio system, PA-STARNet, became operational. In reality, the commonwealth and the vendor developed the next generation of public safety communications software that is now the OpenSky network.

The state has moved PA-STARNet ahead significantly with initiatives aimed at enhancing interoperable communications including system coordination, engineering coordination and connecting all 911 Centers to the PA-STARNet.

## Description

For decades, Pennsylvania agencies that required mobile radio services operated independent systems for their own use. Twenty state agencies had systems that were becoming obsolete—in disrepair due to a lack of funds, in danger of extended outages due to a lack of spare parts and threatened by rickety towers that could easily fall down during the next ice storm. The need for action was great.

Pennsylvania Act 148 of 1996 provided funding for a “[c]ommunication and information infrastructure, including approximately 200 sites located throughout this commonwealth for transmission of voice and data communication connected by a digital microwave system to form a statewide mobile radio network....”

Pennsylvania's Office of Administration, Office of Public Safety Radio Services was created to develop, construct and maintain the new statewide system. Initial tasks included developing cost estimates and an RFP for consultant services.

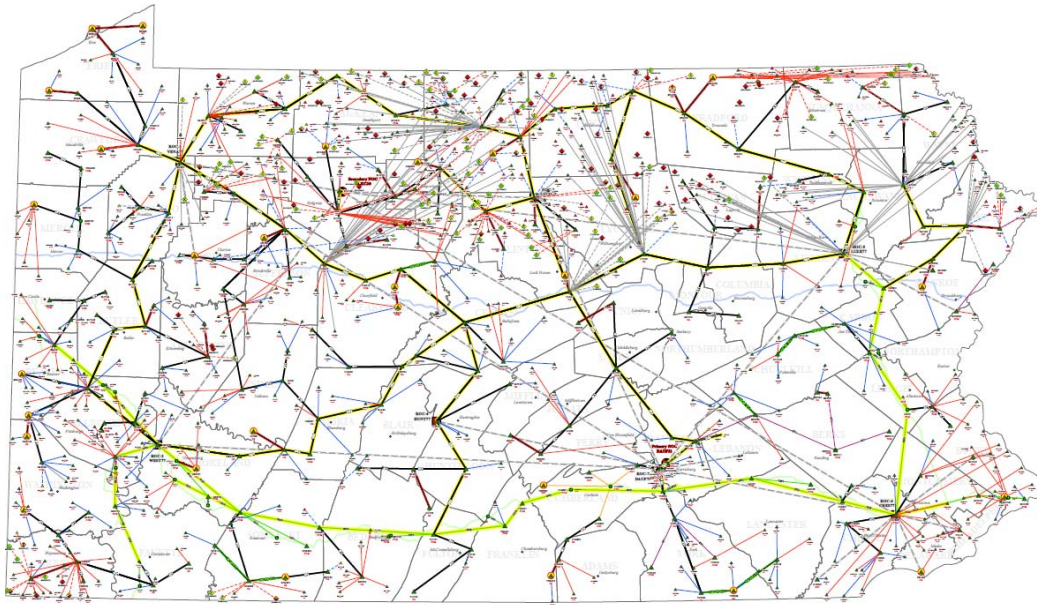
System design and development began with an original objective of replacing incompatible, aging radio systems with a single, centrally managed statewide system supporting both voice and data communications. As planning, design and deployment evolved, the scope of the system expanded significantly, including a framework for interoperable communication with local first responders.

PA-STARNet provides wireless digital voice and data communication services across the commonwealth using the 800 MHz frequency band designated for public safety use. The original 200 sites envisioned by the legislature has grown into 861 sites (236 high-profile towers and 625 micro-cells) which provide VoIP coverage to over 95% of the state's 45,000 square mile landmass. The system also has four Cells-on-Wheels (COWs) that are deployment-ready for whenever and wherever they may be needed.

PA-STARNet uses trunked digital multicast technology from M/A-COM, Inc. (purchased in 2009 by Harris Corporation), a unit of Tyco Electronics Corporation. M/A-COM's OpenSky<sup>®</sup> system makes use of both high-profile multi-channel 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). TDMA allows up to four simultaneous voice conversations on a single channel. The system incorporates standard components such as Internet Protocol (IP) and off-the-shelf workstations, routers and database software.

This unique 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 firewalls, located remotely from each other. Both the geographic dispersion of infrastructure and the ability of components to operate independently help assure availability and survivability.

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.



The microwave pipe extends across the state's 45,000 square miles and originally had a throughput of 45Mbps. It has been upgraded to a Multiple Protocol Labeling System (MPLS) which increase its alternate and restoral capabilities as well as throughput to 55Mbps. Operational coverage currently extends over 95.7% of the commonwealth's landmass and 96.8% of its roads.

There are more than 19,500 subscriber devices authorized to use the system with over 1,000 of those in the hands of nine Regional Counter Terrorism Task Forces (RCTTFs). As many as 3,000 users connect at a given time, initiating some 106,000+ daily transmissions.

Twenty commonwealth agencies use PA-STARNet or are transitioning to it, along with business partners and various local public safety organizations that participate under commonwealth agency sponsorship.

Some examples include the Department of Health which has deployed more than 280 fixed-location radios in hospitals and medical facilities to provide wireless emergency backup and redundancy, by way of a specialized data application on PA-STARNet, for its Health Alert Network. This application provides for text messaging and image transfer. And the Department of Transportation, which uses some 6,700 hand-held, and fixed-station radios to coordinate highway maintenance and snow removal operations.

PA-STARNet repeatedly proves its effectiveness in high-stress situations such as:

- Pittsburgh G-20 Summit, September 2009, where PSP air-to-ground surveillance video was streamed over PA-STARNet to the command center.
- Tactical communications support for PSP units at the Nickel Mines Amish school shootings in October 2006; and
- Planned events such as the Little League World Series, NASCAR Pocono 500 and the U.S. Open.

Unlike the movie *Field of Dreams*, there is no guaranteeing that, “If you build it, they will come.” Getting agencies and first responders to collaborate on a managed system was a major obstacle. Significant change management and a strong emphasis on interoperability was—and continues to be—necessary to move from initial “buy-in” through transition as agencies go live.

OPRS hired two statewide interoperability coordinators, an Interoperability Systems Manager and an Interoperability Engineering Manager. With this investment, the RCCTFs and counties have become more accepting of the statewide system. County 911 Centers have been provided with control stations to access PA-STARNet. Control stations can be used to coordinate resources between any state first responder—such as the Pennsylvania State Police—and local emergency responders.

Adding to Pennsylvania's interoperability are three profiles set aside for interoperability purposes only. Policy and standard operating procedures are being set for the use of these profiles pre-programmed with talk groups on every commonwealth radio. Profile 14—or “INTEROP”—has the benefit of true on-the-fly interoperability while profiles 15 and 16 are set aside as Global Profiles being National Incident Management System (NIMS) compliant and reserved primarily for Incident Command situations.

## Significance

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 commonwealth assets and business processes. PA-STARNet is used for daily communications, planned events and emergency situations—in fact, it was used for 39.7 million push-to-talk transactions last year and tens of millions more data transactions.

PA-STARNet also serves as a platform between state agencies and local first responders—benefitting municipal governments. It plays a crucial role in marshalling, coordinating and controlling activities across all levels of government.

PA-STARNet exemplifies the following best practices:

- A unified and interoperable approach to emergency communication, encompassing both commonwealth agencies and municipalities across the state.
- Consolidation and standardization of technology deployment for fiscal responsibility, economies of scale and shared services.
- A governance structure to ensure that all stakeholders have a voice in setting direction and establishing policy.

## Benefit

Quantifying return on investment for a complex strategic asset such as PA-STARNet is a daunting task—but we will try.

In 1995, the Pennsylvania State Police commissioned a study that estimated a statewide 800 MHz network for their own use would require 298 sites and cost an estimated \$381 million—at 3% inflation, that would be \$560 million today. PA-STARNet has 877 sites and will not exceed the appropriated capital budget of \$368 million.

By way of contrast, over a similar time period, six Pennsylvania counties spent about \$141 million to cover about 3,500 square miles (about \$40,000/sq mile) while PA-STARNet has covered about 43,000 square miles and will cost \$368 million (about \$8,500/sq mile).

In its primary role as a public safety network, PA-STARNet offers dramatic improvement in the ability of emergency managers to control and coordinate resources during emergency response. This interoperable platform for voice and data provides better direct communication for incident command in the deployment of assets.

For example, PSP data transactions include information on warrants, drivers' licenses, missing persons and protection from abuse orders. Through the end of November 2009, PSP had more than 25 million data transactions compared to about 5 million for the same period in 2008. (This increase is largely due to the aggressive migration of additional PSP barracks during 2009.)

PA-STARNet infrastructure also provides automatic vehicle location (AVL), texts, alerts and photos—with responses to inquiries returned in a few seconds. AVL is built around the Global Positioning System (GPS) capability of installed mobile radios for real-time information to support decision-making and coordination.

The commonwealth now has a statewide wireless land mobile-based radio system serving the requirements of all agencies, supporting intermingled voice and data traffic, operating with high availability for roughly the same cost as a new radio system for a single agency. Its infrastructure is decentralized and highly survivable, operating through commercial power outages and largely independent of commercial communications providers.

PA-STARNet serves as the statewide backbone for interoperable communications across all levels and is the basis for a forthcoming broadband initiative to provide last mile service across the state's northern tier.

Specific cost savings, increasing return on investment in PA-STARNet, have come from the three-year aggregated subscriber equipment purchase, saving over \$5 million compared with prevailing discounted contract pricing. The system also saves costs by providing voice and data services that would otherwise require commercial service contracts.

Finally, as agencies continue to make the transition to use PA-STARNet as their primary means of wireless two-way voice and data communications, freeing up legacy system assets such as frequency licenses and infrastructure, the reuse of those assets will further increase PA-STARNet's return on investment.