



Commonwealth of Kentucky

2007 NASCIO Recognition Awards Nomination  
Category: Business Continuity and Disaster Recovery

## **Kentucky Emergency Warning System (KEWS) Digital Upgrade**

*Commonwealth Office of Technology*

This project establishes a state-of-the-art, IP-based microwave communications backbone traversing the state of Kentucky. The network uses advanced, self-healing features that have typically not been available except through national providers like AT&T and Bell. The digital upgrade replaces a thirty-year old, antiquated network at no additional cost to first responder agencies. It provides robust new capabilities immediately, and will furnish new functions, including traffic prioritization and bandwidth-on-demand, as supported agencies require them.



## **Executive Summary**

Recent disasters within Kentucky, including tornadoes, train derailments, floods, airline crashes, and an ice storm that paralyzed over half of the Commonwealth, have clearly tested and in some circumstances exceeded the limits of the existing emergency warning communications infrastructure in Kentucky. In each of these cases, reliance on commercial communications proved fruitless, and the importance of having a dedicated and reliable communications system was obvious.

Other major out-of-state disasters such as the 9/11 attack and Hurricane Katrina have pushed Kentucky to evaluate its public safety infrastructure, and the results of this evaluation concluded that Kentucky's communications capabilities cannot cope with large-scale disasters of comparable magnitude. Simply put, the existing thirty year old, analog KEWS system cannot adequately support multiple first responder agencies in any major incident or disaster, nor is it able to keep up with the continually growing requirements of those agencies. For these reasons, the need to upgrade the Commonwealth's public safety infrastructure continued to grow more critical each year.

The Commonwealth Office of Technology considered several upgrade and replacement solutions in an effort to realize its vision of deploying a robust public safety and disaster recovery solution. Multiple systems were evaluated including fiber optics, commercial outsourcing, satellite, and microwave. In the end, and in no small part due to the lessons learned from the failures of the communications networks in other states, it was decided to replace the existing analog microwave system with a dedicated, state-maintained, self-healing, pure digital, high-capacity microwave network.

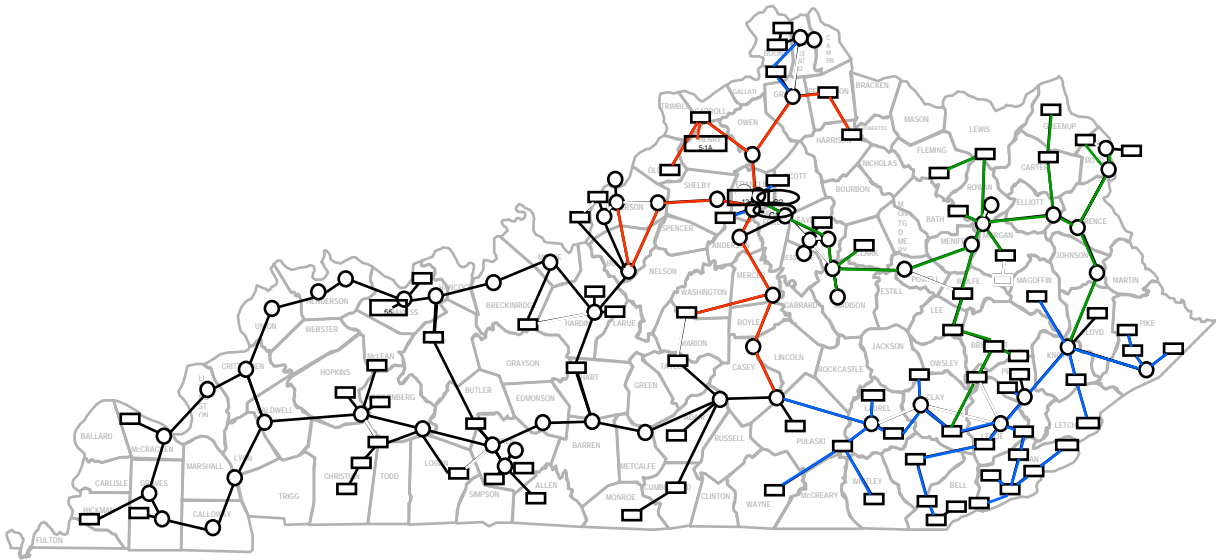
In 2006 Kentucky took its first step of meeting this goal by launching the Kentucky Emergency Warning System (KEWS) Digital Upgrade project. When totally completed, it will provide a superior public safety and disaster recovery system that can best serve its greatest assets -- Kentucky citizens and their families.

## Project Title and Description

The Kentucky Emergency Warning System (KEWS) Digital Upgrade project was commissioned by the Commonwealth Office of Technology as a Design-and-Build project to replace and upgrade the thirty year old KEWS analog microwave infrastructure.

Since the Commonwealth of Kentucky desired a new state-of-the-art network that would serve well into the next three decades, it was decided to deploy digital radio systems still in development by Harris Microwave at the time of the project award. This has the promise of many benefits not available previously, and while the implementation of new technology bears a certain risk, the return on investment is huge. It has guaranteed the Commonwealth the newest technology available and provides at least some degree of obsolescence protection for the foreseeable future.

In order to fully understand the complexities of this project, it must be understood that the existing KEWS network consists of over 140 communications sites in a great variety of locations and geographical terrains. While some sites are located on flat ground with paved roads leading up to the gate, others are atop mountains with miles long winding roads that are little better than trails. The complexity of the KEWS microwave network can be seen in the map below.



Most of the existing shelters, towers, and paths were planned for reuse and have been or will be upgraded as required to accommodate the newer microwave systems. Where necessary, towers are being reinforced, shelters replaced, power systems upgraded, and paths realigned.

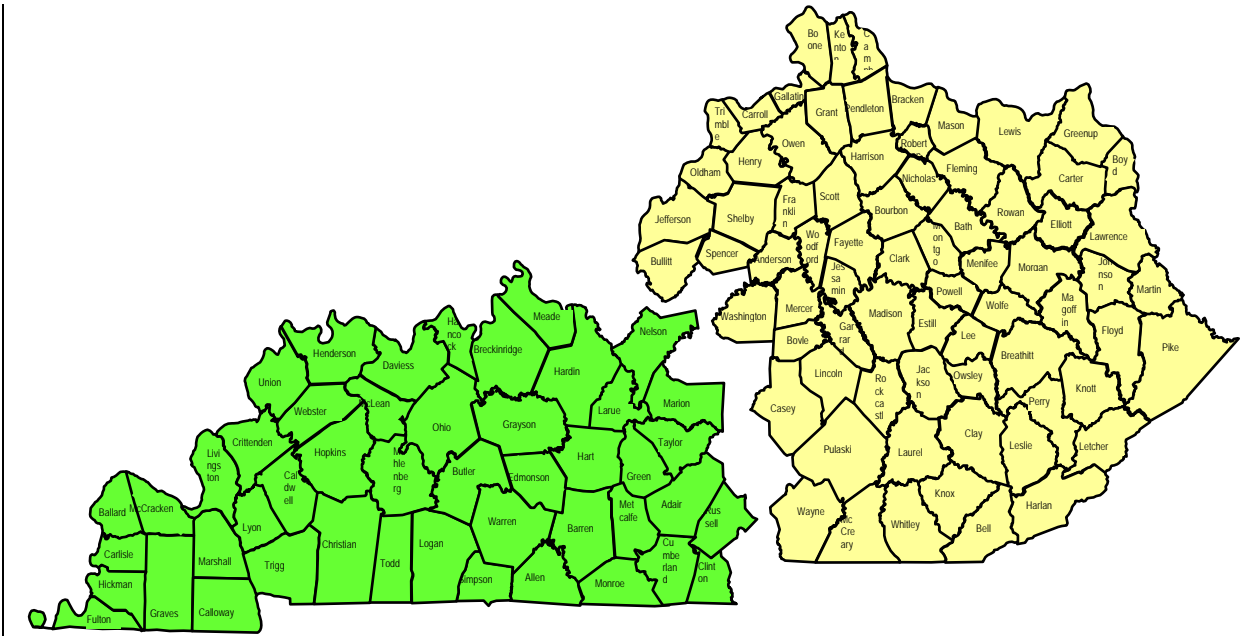
With these thoughts in mind, and to manage the overall scale of this project, it was decided to split the project into two phases; a design and engineering phase, and an implementation phase.

The design and engineering phase required physical surveying and inspection of each site's tower, equipment, microwave path, grounding, and various other elements. These

efforts allowed the team to create a requirements list so that engineering plans could be made for upgrading the system on a per-site basis.

After the planning and engineering phase was completed, the implementation phase began. Once again, much consideration went into planning the implementation phase of the project with major efforts being given to minimize the effect on public safety customers.

Next, the Commonwealth was divided roughly in half for the implementation efforts. The map below shows the final results of the implementation planning. The Eastern Segment (shown in yellow) and the Western Segment (shown in green) are each estimated to take one year to complete. In true Kentuckian spirit, it was decided to handle the toughest job first, and as a result the project began in the mountainous and rugged eastern portion of the state.



As implemented, the new microwave system will provide a modern digital network based on MPLS and IP technologies. The system has been engineered to allow multiple loops, each capable of carrying a full OC-3 (155 Mbps) of data across the loop simultaneously. Additionally, the new network employs resource-on-demand technology uses bandwidth only when traffic is actually being sent, which further expands capacity. Even using the most conservative formulas, these capabilities will increase the channel capacity of the system by an order of magnitude over the analog system. When combined with the increased signal quality inherent in a pure digital signal, the new system will provide a quantum leap in capabilities and quality over the old KEWS system.

## **Significance of the Project to the Improvement of the Operations of Government**

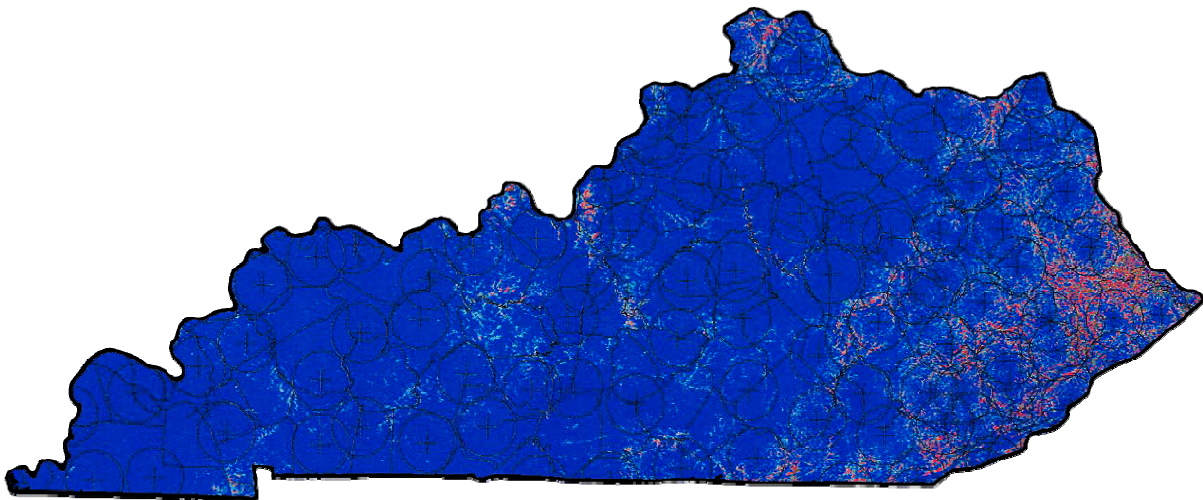
Many of the technology barriers between digital and analog communications, voice and data, switching and routing simply go away with this network. With a guaranteed network reliability rate of 99.9996% coupled with supporting all current technology in use in the Commonwealth today, including the capability of directly supporting Voice-over-IP, Video-over-IP, TDM-over-IP, and other protocols, it can easily be seen that this system will support the anticipated requirements of the Commonwealth for the next twenty to thirty years.

Since the new digital KEWS network will be available across the state, provides high quality bandwidth on demand, allows traffic prioritization, and can heal itself in milliseconds, it will easily handle the estimated 6000 public safety agencies, and can even be pressed into service to backup the telephone systems of government and military agencies as needed.

Another tangible benefit of this project is the tower, shelter, and power upgrades. With the work being done on these areas, public safety agencies across the Commonwealth can partner with the KEWS agency to share these benefits as needed.

### **Public Value of the Project - Benefits Realized by Service Recipients, Taxpayers, Agency or State**

KEWS network towers are strategically located throughout the Commonwealth in direct support of first responder agencies. The map below shows the coverage available for the 450 MHz UHF frequency band. Over 97% of the Commonwealth's area is covered by the KEWS backbone and propagation maps, and while not 100%, coverage is certainly exceptional.



This new infrastructure augmentation provides new capacity not previously available and increases public safety agencies' effectiveness and efficiency in protecting and aiding Kentucky citizens and first responders.

By the state providing and maintaining the KEWS infrastructure, local agencies can place their antennas in excellent positions, hundreds of feet off the ground, and at no recurring cost to the agency. This approach has rightfully placed the cost burden entirely on the state, and frees each local agency to concentrate on its public safety mission and not on expenditures for redundant towers and infrastructure. In combination with economies of scale, circuit connectivity, and the state's commitment to network maintenance, there is enormous benefit to all public safety agencies across the state.

If this infrastructure were not made available, local agencies would be required to construct their own tower system, lease circuits back to their office or desired end-point, and perform long term maintenance on local towers. Since in almost every case, the money simply does not exist at the local agency to construct and maintain these tower sites, not upgrading KEWS would likely have triggered an exodus to less reliable commercial services, reliance on cell phone, or other equally non-protected systems that have proven to fail when needed the most.

The upgrade to the KEWS system provides the following additional benefits:

- Available at no additional cost to first responder agencies
- Allows participants to use their existing equipment
- Uses current staff – no additional staffing is required
- Allows use of the existing infrastructure
- Provides a known set of coordinates with towers
- Provides known coverage for specific areas or over a wide area
- Provides a new high quality backbone for all public safety agencies
- Provides an improved circuit quality for Mutual Aid and Interoperability circuits
- Allows pooling of maintenance responsibilities
- Has a much higher survival factor than commercial services

### **Public Value of the Project - Realized Return on Investment, Short-term/Long-term Payback**

It is difficult to quantify an exact return on any public safety investment since the saving of a single life easily justifies the investment. Considering the mess that can ensue with any major disaster, it can easily be imagined how a self healing, high-capacity communications backbone can aid any and all first responders who require communications at the critical moment that cell towers, telephones, and other communications methods are nonfunctional.

This project provides a premiere solution that will accommodate the current and anticipated communications and bandwidth requirements of the network for the next twenty years or more. Its guaranteed 99.9996% reliability and the ease at which the system can be expanded in capability and capacity easily demonstrate the value of this investment in Kentucky's future. The system is fully engineered to accept the eventual convergence of voice and data technologies and is ready to accept VoIP, broadband, Video over IP today and will accept broadband RF when it is deployed.

One large permanent taxpayer benefit will be realized by eliminating the costs associated with leasing circuits in direct support of various public safety agencies. A case in point is the direct cost savings which will occur by the Kentucky State Police Mobile Data

Network. This network supports many public safety agencies with mobile computer applications linked to a series of databases centrally accessed in Frankfort. This network requires high quality 56Kbps data-grade circuits from each of the 166 Mobile Data sites back to Frankfort. Many of these circuits are unsupportable on the existing KEWS network thus requiring the provisioning and leasing of higher quality circuits from local exchange carriers at a cost of more than \$250,000 per year for this one network alone. With the new Digital KEWS network, many of these circuits are easily accommodated and can be moved to the new KEWS digital backbone to recoup costs directly.

Other circuits supporting VHF, UHF, and 800MHz radio systems at the state level alone total well over 300 radios with many thousands of additional radio repeaters in use by local agencies. All of these circuits can be moved to the upgraded KEWS as the network is built out and operational.

Additional savings can be realized by eliminating and replacing the leased circuits for the telephone switched network, long distance trunks, and other circuits providing connectivity to local agencies. While this scenario has not been analyzed, it is nonetheless an option that is available with a potential savings in the millions of dollars.

Yet another area of additional cost savings will be directly realized immediately and in years to come in the reduction of maintenance call outs associated with implementing a new protected system. Add to this the self-healing, auto-reroute capabilities, remote management and programming capabilities, and the inherent superiority of digital signals, and it can readily be seen that maintenance costs will be significantly reduced.

At a cost of less than \$50 million to complete the upgrade and modernization of Kentucky's Public Safety Infrastructure, and by comparison with other states implementing similar projects, it is evident that Kentucky has a project returning one of the best "bang-for-the-buck" systems today. When averaged over its useful life of the next thirty years, this system costs less than 40 cents per citizen per year and delivers a vastly superior public safety infrastructure and communications network supporting all citizens of the Commonwealth, and pays for itself in potential savings of life and property.