Trends in Mobile Radio Backhaul

As mission-critical organizations upgrade their backhaul networks, data and new technologies force changes.

By David Christophe

Alpowa Summit SCR radio site, Wash.

Photo courtesy Washington State Department of Transportation

Mission-critical organizations are transforming their mobile radio backhaul networks. The need for such change became evident as mobile workers were equipped with communications capabilities that enhance safety in a complex environment of increasing service demands. This article highlights lessons learned in mobile radio backhaul transformation.

Mobile workers use communications for enhanced safety in an increasingly demanding service environment. Public-safety agencies, power utilities and rail operators face several common challenges, including interoperability, security, bandwidth efficiency, multimedia information, reliability, costs and traffic growth.

Traffic growth must be supported while costs are controlled. In the United States, increased mobile radio bandwidth efficiency is needed to comply with government narrowbanding regulations. New multimedia applications require a significant amount of bandwidth, and some may tolerate only a few seconds of delay to be relevant.

For those with analog mobile radio systems, these challenges have typically led to digital upgrades, along with growth in the network footprint to enhance coverage. Often this is the primary catalyst for change in the mobile radio backhaul network.

Backhaul as a WAN App

Many public-safety agencies, power utilities and rail operators initially built separate communications networks for each major application. These networks used a mix of technologies such as time division multiplexing (TDM), asynchronous transfer mode (ATM) and synchronous digital hierarchy/synchronous optical network (SDH/SONET), and required different skills and management systems to operate. These networks generally have been in place for a decade or more, with capacity nearly exhausted and equipment near or at the end of its economic life cycle and availability. When faced with the need to support new video surveillance, smart grid and passenger information applications that are all IP/packet based, one option is to deploy yet another application-specific network. But to reduce operational costs and increase flexibility and operational efficiency one choice is an evolution to a converged multiservice wireless access network (WAN) that supports digital mobile radio traffic backhaul along with all other mission-critical and IT applications traffic.

The technology for Project 25 (P25) traffic backhaul along with support of data, voice and video applications traffic on a converged, multiservice network includes carrier Ethernet. Carrier Ethernet extends the benefits of Ethernet into the WAN to effectively address IP-based traffic growth. This is integrated with either IP/multiprotocol label switching (MPLS) or packet optical transport for high reliability, performance and manageability.

A growing trend is the use of packet microwave for transport where fiber facilities are not available. As traffic grows, wave division multiplexing (WDM) is added in the core for cost-effective capacity scaling. Network simplification and cost reduction are achieved with common end-to-end service/network management of the converged WAN. During the transition, existing staff are trained for an efficient transformation.

Public-Safety Agencies

When agencies upgrade their mobile radio systems, they often evolve their backhaul networks as well. Typically an application-specific network becomes an application on a converged WAN. For many agencies, this evolution has coincided with the trend toward cooperating agencies combining traffic onto a common network. This converged, multiapplication, multiagency WAN greatly enhances interagency interoperability. It also provides several benefits such as increased flexibility to introduce new applications, enhanced availability and shared/lower costs.

Public-safety agencies that have transformed P25 backhaul traffic support to a converged multiagency WAN, along with other mission-critical and IT applications, identified several key lessons learned. For many, the planning process resulted in stronger relationships between agencies and improved collaboration. Planning discussions on particular communications needs of each agency often led to discussions on how a communications service would be used at a specific type of incident and then the resulting definition of joint operational procedures. The planning, exercises and training were identified as good for team building and helped foster enhanced cooperation. Overall project schedules need to account for the creation and alignment of operational plans for agencies that operate together, as well as for network upgrades.

Creating a multiagency network often enhances communications reliability that was not possible with previous agency-specific networks. For example, backup centers, particularly for smaller centers or those located in smaller towns, now become economically feasible. With a common network, connectivity to CAD systems can be established rapidly and securely at a temporary backup center if the primary center is not available.

Systems have evolved to an IP/MPLS-based WAN, and mobile radio backhaul traffic is one of the many applications converged on the WAN.

The new network architecture typically incorporates a design that better protects against disruptions with redundant alternate paths to major locations and key sections of the backhaul network through new microwave links and shared agency network assets. At the same time, the network is engineered to ensure each agency has the required network autonomy and assurance of traffic performance through quality of service (QoS) and traffic engineering capabilities.

Over time, first responders will be able to maintain communications with their home dispatch centers while in another agency's jurisdiction that is supported on a common WAN. This will enhance the safety of a first responder, for example in a car chase as it extends into another jurisdiction.

Increased efficiency and cost savings are being realized, for example, from combining the public-safety, mission-critical and IT applications traffic on a common network. In addition, a common network in which network resources can be shifted to support a change in the mix of application traffic makes it easier and less costly to introduce new services. Allocating the necessary time for training on the new technology is critical — and often a challenge in light of the demands of supporting daily activities. The converged WAN also provides the foundation, such as the bandwidth and low latency support, for backhaul support of mobile broadband communications with Long Term Evolution (LTE).

Power Utilities

Utilities identified several key lessons learned. Several stressed the importance of fully understanding existing telecom services and how they are used. This was identified as especially important for legacy applications still required to run the power grid.

The data gathering and planning tend to be an iterative process. For some utilities, meetings or workshops were held with people at several levels within each organization — from department heads to employees using the telecom service. Gaining user input on requirements is important when an organizational change is made in conjunction with the communications transformation. For example, organizations in several utilities each previously managed their telecom services. The field operations group managed the services to support supervisory control and data acquisition (SCADA) and teleprotection, and corporate IT managed voice and LAN interconnection. The consolidation of all traffic onto a converged WAN was accompanied by combining communications management with a newly created centralized department for WAN management. This department included members from each organization who previously managed their respective telecom service. This usually led to the internal adoption of a service provider model, where the field operations and corporate IT became customers of this centralized group for telecom services. It's important to identify a lead engineer for each service. The lead engineer will work with the organization that uses the service to define the requirements such as bandwidth and latency, as well as the performance metrics, to ensure that traffic support on the converged WAN meets their needs.

Moving from TDM and SDH/SONET technologies to IP/MPLS and/or packet optical transport solutions requires new skills. It's important early in the process to identify the required skill set for the new technology, the staff and a training plan. Lab testing was also identified as essential to develop the necessary baseline for field deployments.

Because communications is the common foundation for smart grid applications, it makes sense to build this first. A converged WAN must support existing services with infrastructure that is open and flexible enough to support future applications and modes of operation. Communications transformation can be seen as part of a transformation of the overall business.

Rail Operators

Rail operators are upgrading their networks to accommodate new video surveillance, signaling and passenger information and automated ticketing solutions that are typically IP based. This has been accompanied by an evolution to an IP/MPLS-based WAN, and mobile radio backhaul traffic is one of the many applications converged on the WAN. The WAN supports applications that enhance safety and passenger experience and optimize efficiency. Transport of signaling and synchronization of GSM-R base stations in particular are key areas of focus during the transformation.

Rail operators identified several key lessons learned. Several stressed the importance of focusing on the aspect of adapting existing services to the network. In particular, some services may have been in place for decades — such as alarms that control area access, and are critical to safety and efficiency — but may not have been supported by clear, readily accessible records. The design practices should be examined to determine if the processes need to be updated and require different skills. For example, a design practice that has worked for decades for services on a TDM network may need to be refined to facilitate the effective design for IP-based video surveillance support, with efficient replication of streams for viewing at multiple centers and storage at another site with an IP/MPLS WAN.

Operators that have completed this network transformation identified that a thorough training program for all technical staff, as well as select management personnel, is needed. Plans need to reflect the time to train a technical staff who had managed in a TDM and/or SDH/SONET environment for several decades. More importantly, plan the time for people to change. ■

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