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Regional Interoperability in the Midwest



A Kansas City area Project 25 (P25) network serves as a benchmark for multistate and regional public-safety radio communications.

By Jack Hart

Photos courtesy Deputy Chief Kevin Cauley of Leawood Police

The Metropolitan Area Regional Radio System (MARRS) 700/800 MHz Project 25 (P25) simulcast digital trunked system of systems is located in some of the most densely populated and tornado-prone counties in the Midwest. The system straddles the borders of Missouri and Kansas and serves more than 30,000 users in the greater Kansas City metropolitan statistical area.

In less than eight years, MARRS has evolved from several incompatible, vendor-proprietary trunked systems and a conglomeration of conventional VHF, UHF and 800 MHz local systems into an integrated network that covers more than 4,000 square miles and serves a population of 1.2 million people. The entire system is designed to serve a portable on-hip user.

MARRS consists of six large simulcast nodes plus multisites, for a total of 48 tower locations. The system supports radio traffic generated by more than 200 public-safety and public-service agencies across six counties — four in Missouri and two in Kansas — including 24 public-safety answering points (PSAPs). On an average day, system use is less than 50 percent, allowing sufficient available

Two multisites were configured as four-channel 700 MHz stand-alone trunked P25 sites that affiliate with MARRS based on the talkgroup being used within the coverage area of the site.

radio channel headroom for increased call volume because of a major incident or multiple incidents.

Coming of Age

First commercially introduced in the 1970s, trunked radio systems have become the mainstay of large public-safety, transit and utility radio networks, including MARRS. The widespread adaptation of the technology became possible in the late 1990s when the Association of Public-Safety Communications Officials (APCO) International began developing a digital trunked radio standard that provided a common air interface for vendors to use. Before then, each vendor's trunked radio system used proprietary signaling, which stifled interoperability. Known as P25, it has become the de facto standard for public-safety communications in the United States. As a result of the communications issues experienced during the events of Sept. 11, 2001, the federal government strongly encourages its use.

As technology improved, trunked call-handling efficiency kept pace with user base growth. P25 systems support user features such as unit-to-unit calling, over-the-air (OTA) programming and encryption key changes, high-quality audio, highly reliable user ID and emergency capabilities, and other features.

Trunking not only allows for more efficient use of a finite number of radio frequencies, it also allows for a large user base, such as MARRS, thus accommodating police, fire, EMS, public works, health services, code enforcement, emergency management, utilities and other governmental agency needs. Legacy conventional systems often use VHF and/or UHF radio channels for different agencies. For example, fire might be on VHF and police on UHF. While each radio band has its benefits and drawbacks,

the fact that the agencies are on separate bands makes interoperability difficult or requires personnel to carry multiple radios.

A major benefit of trunked systems is that everyone is on the same system, even when their operations remain separate. Agencies are no longer isolated on their assigned radio channel; users can communicate by selecting the target agency's talkgroup on a radio and pressing the push-to-talk (PTT) button. Trunked radio system technology has enabled the efficient use of limited radio spectrum, while greatly improving the ability of first responders to intercommunicate.

MARRS Evolution

The MARRS concept took root as several local radio communications systems could no longer meet user capacity demands. At the same time, those systems faced equipment obsolescence, necessitating the move to P25. While the city of Independence, Missouri, had already transitioned to P25 — the first 700 MHz P25 system in the country — Kansas City, Missouri (KCMO), was challenged with upgrading its legacy APCO 16 EDACS trunked system. Population growth, coupled with first responders' need for improved in-building portable service, led KCMO to release a request for proposals (RFP) specification for a P25 system upgrade in mid-2008. Johnson County, Kansas (JOCO), KCMO's western neighbor, wanted to consolidate its multiple conventional VHF, UHF and proprietary analog trunked radio systems into one county-wide radio network. JOCO published its P25 RFP specification in late 2007.

Once KCMO and JOCO settled on a system vendor, they investigated an operational consolidation of their two systems. A regionwide organization already in place — the Mid-American Regional Council (MARC) — that

oversees 9-1-1 telephony systems throughout a nine-county area led to the creation of the system. MARC became the focal point for the eventual development of MARRS, contracting with Tusa Consulting Services to develop a governance structure model and ongoing consultation that would guide the wide-area network's evolution. Although the KCMO and JOCO radio systems each continue to operate autonomously, a user can seamlessly roam between them by using regional talkgroups that function on both systems. While the claim that a fireman in one town can talk to a policeman in another town is technologically correct, it's an unlikely scenario. However, if a major incident occurred, the command staff within the various agencies and jurisdictions would need to intercommunicate. This is where MARRS' comprehensive operational and coverage capabilities truly shine.

As MARRS matured, the FCC's 2013 VHF/UHF narrowbanding deadline prompted many independent governmental entities within the region to investigate the cost of improving their legacy analog radio systems or transitioning to digital technology. Motorola Solutions supplies the network infrastructure, and multiple vendors provide subscriber units.

As towns, cities and counties within MARC saw the benefits of the P25 trunked radio technology firsthand through KCMO and JOCO, they began developing their own transition plans. In some cases, the purchase of P25 subscriber equipment and a local radio dispatch center upgrade were all that was needed; in other cases, new tower sites were added to the MARRS network for improved coverage in the local area. Platte and Cass counties in Missouri and Wyandotte County in Kansas built their own countywide P25 systems, taking advantage of the KCMO/JOCO redundant system control architecture to integrate their systems into a regional network.

Two multisites were installed along the eastern border of the original MARRS configuration to cover areas not served by KCMO or Independence. These were configured as four-channel 700 MHz stand-alone trunked P25 sites that affiliate with MARRS



Multiple agencies respond to emergencies through MARRS' integrated network.

based on the talkgroup being used within the coverage area of the site. For example, if a local town police unit that is covered by a multisite is communicating with another town unit, the call stays on the single site. If that unit switches to a county or regional talkgroup, the call is automatically carried across the affiliated simulcast system, in this case, the KCMO radio system.

Regardless of the technology, coverage is king in radio system planning. The design must take into account where portable radio devices will be used and how.

Conversely, if a county deputy drives into the multisite's coverage area, that deputy's radio automatically registers onto the site and advises MARRS that it should direct any county calls to the site. This solution came at a fraction of the cost of building a full 28-channel simulcast site. The two towns where the multisites are located enjoy their own private trunked radio sites, unless they need to communicate with the county. Then, they dial their radios to a county or regional talkgroup and talk.

The communications resources within MARRS — radio tower sites and dispatch centers — are internally connected by dedicated fully redundant loop-microwave ring systems, which in turn are interconnected to adjacent regional microwave systems. MARC, as the regional manager of the 9-1-1 telephony system, has upgraded all PSAPs with new next-generation 9-1-1 (NG 9-1-1) telephone equip-

ment, which is interconnected via the comprehensive regional microwave network. Previously, all PSAP 9-1-1 telephones were connected via expensive and unreliable leased T1 circuits. Every PSAP now has a redundant microwave connection with pathways that connect the radio dispatch and NG 9-1-1 systems into the regional network.

MARRS was recently interconnected to the Missouri Statewide Wireless Interoperability Network (MOSWIN), a Motorola Solutions VHF P25 trunked radio configuration. Interconnection of multiple trunked radio switches was accomplished via the P25 Inter RF Subsystem Interface (ISSI) standard.

Coverage is King

Large radio systems can either be planned from the onset as blank slate systems, or they can evolve in steps, as MARRS did. No matter how the process starts, the ultimate goal is to provide optimal coverage to the user entity — town, city or county. In the case of MARRS, Tusa advises agencies to holistically assess coverage within their jurisdiction's critical buildings such as hospitals, schools, jails, courthouses, police headquarters and more. For example, when the city of Riverside, Missouri, was considering

joining MARRS, administrative personnel realized they had mobile radio spillover coverage via the existing KCMO radio system, but portable on-street and critical in-building coverage was unsatisfactory. As the system's designer, Tusa recommended a new tower site to meet portable radio needs, and the site was integrated into the KCMO configuration. By doing so, Riverside now experiences excellent on-street and in-building coverage.

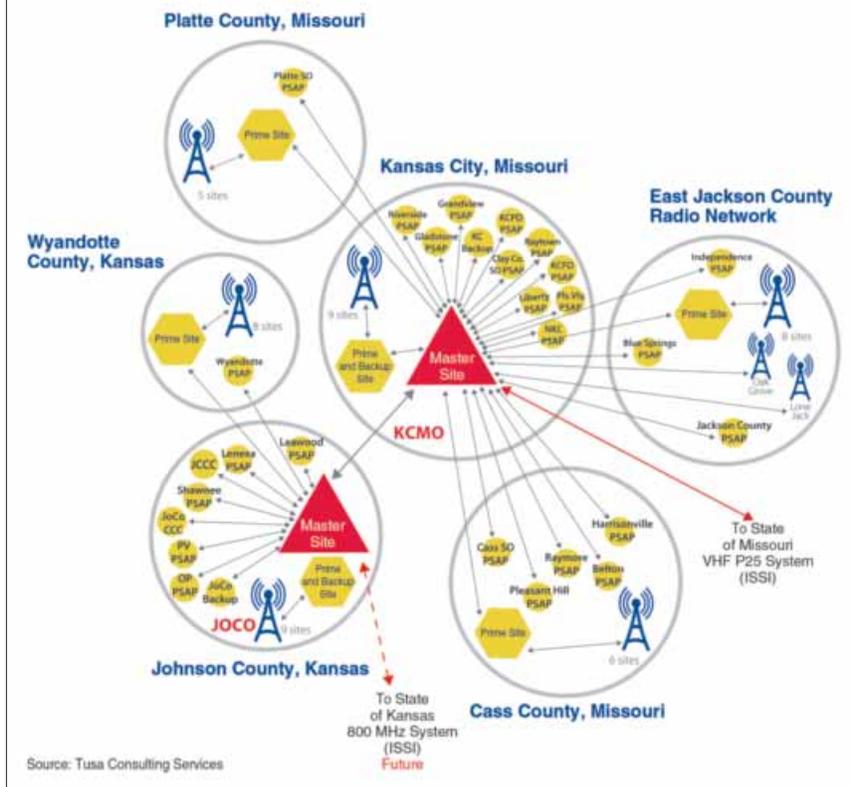
Regardless of the technology, coverage is king in radio system planning. The design must take into account where portable radio devices will be used and how. Think of designing a house. The architect does not depend on the light emitted from a hallway ceiling fixture to light the living room. Lighting fixtures have to be placed where users need them. The same holds true with radio system designs. Many legacy conventional FM systems were configured with sites on highly elevated locations often situated well outside of town. Years ago, that worked well when users operated 100-watt radios solidly affixed to automobiles and trucks, but it is unsuited for effective low-powered portable radio communications within buildings.

Of course, for an expansive radio network covering thousands of square miles, portable radio coverage will be lacking in some areas. MARRS is no exception, as the construction of such systems naturally evolves with time. The MARRS design team continues to investigate the addition of new tower site locations to enhance coverage, in step with suggestions from MARC's radio user community. Implementation is just a matter of time and funding.

Talkgroup Structures

MARRS has a hierarchical talkgroup structure that starts at the local level and transitions to statewide access. All P25 user radios, regardless of manufacturer, have a talkgroup selection switch, or buttons, and an associated mode selection switch, or buttons. A mode or zone typically consists of 16 talkgroups. For example, the first zone in a police radio would be comprised of everyday talkgroups used by agencies such as

Metropolitan Area Regional Radio System (MARRS)



police dispatch, police tactical, police encrypted, special weapons and tactics (SWAT), traffic and others. The second zone would include other town public-safety agencies including fire dispatch, EMS and more, and the third would include town public service agencies such as public works, the parks and water departments, and so on. All police radios in the MARRS region have a single “PURSUIT” talkgroup; police, fire and EMS radios all have a medical helicopter or “MED HELO” talkgroup. Some public works departments have a “SNOW” talkgroup; when the snowplows are on the road, they all know where to listen. Likewise, a PSAP talkgroup for dispatch center use helps coordinate radio operations

across jurisdictions and serves as a backup to the telephone system.

The assignment of citywide talkgroups on a shared trunked radio system allows all agencies to meet on a common channel to coordinate activities and resolve crises. Development of a comprehensive talkgroup plan, or template, is critical to taking advantage of the trunked system’s full capabilities. Finalizing an acceptable talkgroup structure — and gaining widespread concurrence — can seem as daunting as constructing an entire multisite trunked radio network.

Trunked radio systems now offer a powerful solution to daily and peak-normal communications needs, yet such capabilities are nearly useless if people are unsure how to properly

operate assigned equipment. Training must be reinforced to gain equipment familiarity and to discourage bad operational habits from taking root. Training users on how to efficiently navigate through a maze of talkgroups is an ongoing and necessary challenge.

A Sparkling Success Story

Local agencies continue to join MARRS as need and funding allow. Tusa has helped MARRS find more cost-effective solutions, such as releasing subscriber radio RFPs to solicit pricing from vendors of P25 mobiles and portables. Public works departments don’t need high-cost bells-and-whistles radios that provide custom configurations, such as connecting a foreign vendor P25 radio to a legacy dispatch console. With Missouri, Nebraska, Kansas, Illinois and Arkansas operating P25 radio systems, and Iowa and Oklahoma pursuing statewide P25 systems, the entire central United States will soon be covered by compatible, open-standard digital radio technology.

MARRS serves as a benchmark for multistate, regional public-safety radio communications. A contributing factor to its successful development was the high level of cooperation among the region’s many public-safety agencies — something that not all jurisdictions enjoy. According to McClatchy Co., “Kansas County’s Metropolitan Area Regional Radio System is known as a sparkling success story in the nation’s push for seamless communications among public-safety workers.” ■

Jack Hart, senior consultant at Tusa Consulting Services, has been the lead radio consultant for MARRS and continues to support the growth of the network. He has more than 40 years of experience with the design, deployment and operation of large radio networks. Email feedback to editor@RRMediaGroup.com.

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