Why Broadband Won't Replace LMR Anytime Soon

A phased approach that will see parallel broadband and narrowband networks for the foreseeable future is the most pragmatic option.

By Joe Ross and Rick Burke

Long Term Evolution (LTE), the Third Generation Partnership Project (3GPP) standard selected by the public-safety community, is a powerful technology. Public safety will benefit tremendously in the coming years by adopting LTE and deploying broadband applications. However, for the foreseeable future, the benefits will be complementary to narrowband systems.

The industry should work aggressively to solve broadband's shortfalls specific to public safety, and have no illusions about the challenges that it faces. Fundamental and groundbreaking advances in public-safety communications can occur with broadband technologies, but they may not occur if public safety invests all of its effort in replacing narrowband technology.

LTE Voice Challenges

Talkaround. The need for public safety to operate directly from unit to unit absent infrastructure is no secret. Some call it talkaround; others call it peer-to-peer or direct mode. It's a solution that is simple and effective and is available if the underlying mobile radio communications network fails. LTE does not offer such a capability.

Officials from the Public Safety Communications Research (PSCR) are pushing the issue within the 3GPP and seem to be gaining some traction. But even if the 3GPP takes on direct mode, it may not be a solution that fully solves public safety's needs.

Another challenge for broadband peer-to-peer is applications. With Project 25 (P25), the application is fundamentally built into the standard. With broadband, an application layer must be included to allow users to share voice information. This means that the standard must accommodate this off-network scenario, and it must address it in a way that provides both flexibility and security so that an open platform does not present a device security risk.

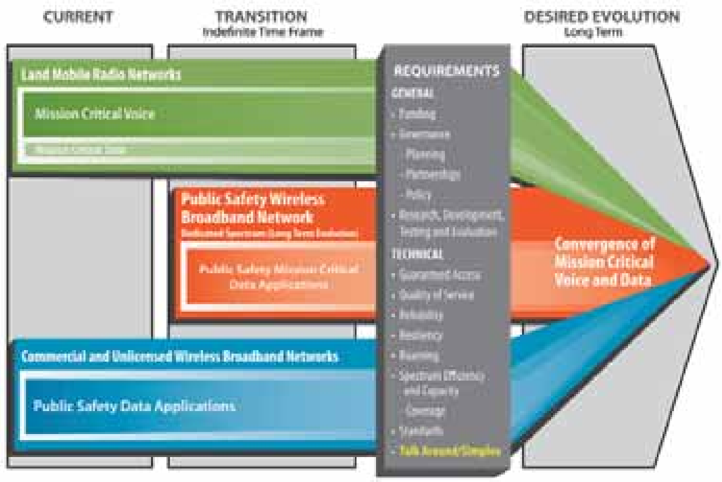
Coverage. The range of LTE is far less than that of an LMR radio at the same frequency. This is due to a variety of factors including low output power of an LTE device, high-power base stations and other factors on public-safety subscriber devices. But because a direct-mode solution is not on the horizon, excellent in-building coverage is needed to start. Broadband systems can require several times the number of sites compared with two-way radio at the same frequency and the same coverage objectives. When compared against coverage from a VHF mobile radio site, the coverage differential is even more significant.

Public safety will likely require the same or better broadband coverage levels as the commercial carriers. While the carriers built this level of coverage because of capacity, the public benefits from the coverage nonetheless. In-building coverage is costly, but if broadband is going to become the future for public-safety communications, in-building signals will be imperative.

Coverage in mountainous terrain is different with LTE. In LMR systems, a mountaintop site is a preferred network design option and delivers an extensive coverage footprint. However, in LTE broadband systems where frequencies are reused at every site, mountaintop and tall sites are highly problematic.

Funding. Without funding for a nationwide broadband network, a transition will not be possible. The funding must consider the capital costs to

Public-Safety Communications Evolution



Source: Department of Homeland Security

deploy the network and the cost of operations. Presumably, state and local governments would pick up the majority of the tab for operations. Therefore, the cost to operate the network must be affordable to those entities. Public-safety agencies are spending money on commercial broadband services and private narrowband services. That funding could be repurposed to the nationwide broadband network if the network completely met the functions of those systems.

Some of the less expensive estimates for the capital buildout of a nationwide broadband public-safety network are $6 billion, unlikely to result in a network that is affordable to operate unless public safety can derive sufficient value from the commercial use of the D block spectrum. But a commercial partnership brings along a whole suite of concerns for many in the public-safety community.

The Opportunities

National Interoperability. Interoperability is multidimensional. Many regions throughout the country have successfully tackled interoperability. Agencies use mutual-aid conventional channels, focus on common radio programming, interoperability gateways, migrating toward the P25 Inter Subsystem Interface (ISSI) or some combination of these solutions. Many urban areas want interoperability to occur on trunking systems because of insufficient mutual-aid resources or the inherent benefits of integrating those communications with existing trunking networks. Therefore, in those circumstances, even when the frequency and technology — for example, 800 MHz and P25 — of the incoming roamers is the same, the incoming radios may not be able to operate on the local network.

While a region can interoperate directly on local networks, when a major disaster hits and mutual aid is provided from outside the region, those incoming radios may not be programmed to operate on the local trunked systems, use disparate frequency bands, and are unlikely to be interconnected via the ISSI. As a result, many regions have purchased large radio caches to accommodate interoperability. LTE is inherently capable of not only nationwide roaming, but also global roaming. There are various issues to overcome regarding nationwide roaming on LTE, but they are largely funding related. In other words, the technology exists to provide nationwide roaming using LTE. The problem, however, is a nationwide application standard. There is a tremendous promise for broadband to serve as the "glue" for nationwide interoperability on trunked systems.

Improved Incident Voice Communications. Ultimately, the question is what broadband applications require peer-to-peer connectivity. This is where we will benefit from peer-to-peer data. And while we solve that problem, we might as well solve an underlying mobile radio problem — challenges in managing wide-area and tactical communications. The benefit of packet data technologies is that any device can easily act as an intermediary. The creation of a mesh network at the incident scene could bond the wide-area and incident-area communications together. In addition, a high-speed networking technology could have underlying geolocation capabilities that provide three-dimensional identification of first responder locations inside a building.

A Pragmatic Approach

Clearly, a number of challenges face the ability to replace narrowband communications using broadband networks. But the challenges shouldn't prevent us from trying, because the benefits of integrated voice and data systems are significant. Public safety could place too much emphasis trying to solve the mission-critical voice issue and overlook fundamental low-hanging broadband fruit. Parallel efforts could capitalize on a broadband network immediately while avoiding the distraction and polarization of the public-safety community for mission-critical voice. Estimates are that each of the following phases would take at least five years.

Phase 1: **Standards and parallel network development.** Push-to-talk (PTT) application standards are developed in earnest while narrowband systems continue to provide all mission-critical voice capabilities. In this early phase, all PTT communications occurs over narrowband systems, including trunking, conventional and talkaround communications. Broadband systems support applications that largely exist in today's marketplace. If we launch PTT before a standard exists, we'll have the same problems that we've had during the past 20 years.

Public safety should simultaneously begin pursuits to develop a peer-to-peer broadband standard. The standard should provide equivalent coverage to narrowband public-safety systems, and it should also facilitate indoor three-dimensional geolocation. Importantly, public safety should immediately begin efforts to determine the frequency band for broadband direct-mode communications. If unlicensed spectrum bands are impractical, then a dedicated band may be required for reliable communications. Public safety may require an additional spectrum allocation, or it may have to carefully repurpose existing spectrum.

Phase 2: **Limited PTT over broadband and parallel network development.** A broadband standard for PTT would be available in this phase. Radio users that don't require talkaround or mission-critical voice would begin to migrate to broadband after successful field trials prove that the networks, devices and applications provide the required level of robustness. First responders would continue to operate on traditional mobile radio networks, while some other users could operate on an interconnected broadband network.

Hopefully in this step, public safety would gain traction in its efforts to standardize a direct-mode standard. Importantly, a decision about which spectrum band to be used for direct-mode communications should be made. Public safety would then begin the effort to secure this spectrum at that time. The optimal spectrum for direct mode could be the 700 MHz narrowband allocation that Congress is considering taking back from public safety. The broadband transition that Congress anticipates could be handicapped by its potential take back of an important spectrum allocation.

In this phase, public safety will develop the extensions to the PTT application standard to allow off-network mission-critical voice. Security standards associated with direct-mode communications should be included in this work. Additionally, other standards, such as biometrics, should be developed and integrated into public-safety communications.

Phase 3: **Pilot broadband deployments with rural and mountain developmental efforts.** In this phase of the process, public safety should begin piloting the overall broadband solution in a first responder environment. This would include communications over LTE networks outdoors, as well as leveraging mesh networks and the peer-to-peer extension of the application standards indoors and off network.

In addition to mitigating PTT over packet-data technology issues, public safety would begin solving the remaining issues regarding broadband network availability. This means solving coverage problems in rural areas and in mountainous areas. Public safety might determine that terrestrial broadband is not well suited for these hard-to-reach areas. Instead, satellite communications may be a more economical solution. In addition, satellite communications could serve as a backup to terrestrial networks. But a geostationary orbit satellite solution is unlikely to provide the kind of coverage needed. Public safety might then require more expensive low earth or middle earth orbit solutions.

Finally, during this phase, the vendor community must develop robust fallback mechanisms available in mobile radio systems. LTE systems have single points of failure that are simply not acceptable for mission-critical public-safety systems. Vendors need to resolve these issues.

Phase 4: **Vigilance, trials and perfection.** Two-way radio systems are not complex, facilitating high reliability. Can broadband systems, comprising LTE networks, mesh networks, subscriber device operating systems and PTT applications all operate reliably and affordably? Perhaps we are captivated by the capability of smartphones and wondering why public safety can't have improved access to these devices. But these devices are not nearly as reliable as a public-safety radio. The complexity of the software in the smartphones means more code and more room for error. Device and software developers can develop a highly reliable device, but there is potential for escalating costs associated with the public-safety branch of broadband product development. The industry must be vigilant in balancing cost and capability with regard to future devices.

It is an important and noble cause to develop solutions that would allow broadband to replace narrowband. However, our first responders deserve the benefits of broadband now and it may be the case that narrowband can't ever be replaced. Direct-mode narrowband solutions might always be required to ensure that a simple and reliable fallback is always available. So we should move forward quickly and pragmatically to ensure broadband technology evolves into what public safety needs but maintain a realistic view of the importance of mobile radio systems that serve public-safety now and into the foreseeable future. ■

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