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EXECUTIVE SUMMARY

LTE and LMR: Planning for the Future

- LTE will eventually supersede LMR, but the transition will take years.
- Many more LTE towers will be needed to replicate LMR's coverage.
- LTE will enable new public safety applications.
- FirstNet, a government-chartered entity, will build a national broadband network for public safety agencies.

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EXECUTIVE SUMMARY

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Overview

LMR (Land Mobile Radio), which has served first responders well for nearly a century, is showing its age, particularly in comparison with the new 4G LTE (Long Term Evolution) cellular networks that commercial carriers such as Verizon and AT&T are beginning to implement.

LMR's limitations were apparent during 9/11 and Hurricane Katrina, when police officers, firefighters, and medical personnel in the same city were unable to communicate. In addition to interoperability, the new technology provides video and document access, which will enable a wide range of new public safety applications. However, the migration must still overcome a series of technical, logistical, and financial hurdles.

Recent federal legislation authorized the development of a national first-responder network based on the LTE platform. Many details of the transition, however, await clarification from the FirstNet governing board.

Context

A panel of LMR and LTE experts discussed the challenges ahead for the transition to a new national public safety network.

Key Takeaways

LTE will eventually supersede LMR, but the transition will take years.
Although 21st-century LTE enjoys many functional advantages, LMR has been optimized over generations for unique public safety requirements; the migration from the legacy solution to a contemporary one promises to be an extended one.

In addition, LMR systems grew up organically around the country. Despite regulatory efforts, they are generally unable to communicate with one another, often even within the same city. This lack of interoperability became apparent on 9/11/01, when firefighters couldn't coordinate with police and EMT services in a timely way. As an international telecommunications standard, LTE offers an opportunity to link these disparate agencies across the country.

> *It's not rocket science, but it's important that decision makers keep an open mind and try to grasp the differences in the way these two systems operate.*
>
> Andrew Seybold

With vigorous competition in the consumer sector, major carriers such as Verizon and AT&T are starting to roll out LTE networks that handle high-speed voice, video, and data transmission for smartphones and tablets. Public safety officials, who rely now on LMR for voice (and limited data) communications, see LTE as the platform that enables a wide range of video-rich event-monitoring and information-distribution applications—and replaces LMR.

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Before that can happen, however, a specialized version of LTE must be "hardened" and improved to handle mission-critical requirements, such as:

- **Operational integrity under disaster conditions.** First responders need a system that continues to function even when commercial systems fail. That means redundant architecture, backup power generators, and other alternatives.
- **Unimpeded information flow.** When an event occurs, a commercial LTE network can slow under subscriber and media traffic in the immediate area, and this effect worsens at the edge of a cell. Public safety workers need instant access, not "searching for signal" messages; their LTE network will have its own dedicated spectrum (at 700 MHz), strong security, guaranteed quality of service (QoS) levels, and more than enough capacity.
- **Device-to-device and broadcast communications.** LMR systems use radio towers like LTE cells for dispatching purposes. Individual LMR handsets, however, can bypass the tower and communicate as walkie-talkies, which allows first responders to coordinate their activities even when a tower or a repeater is out of service. In addition, current LTE technology enables only one-to-one connections, not one-to-many ("calling all cars").

LMR Master™ S412E featuring 8.4 in. Daylight Viewable Touchscreen
Compact Size: 273 mm x 199 mm x 91 mm, (10.7 in x 7.8 in x 3.6 in), Lightweight: 3.6 kg, (7.9 lbs)

As its name implies, LTE has been designed as an evolving platform solution and not a fixed specification, so these enhancements will eventually arrive, given adequate funding and unambiguous governance. Some observers look to a 2018–2020 timeframe for these goals to be met; others wonder if LTE will ever entirely supplant LMR, particularly in rural areas. In the latter scenario, the two technologies would co-exist as "layers." On the other hand, the cost of maintaining two parallel networks may be prohibitive.

Many more LTE towers will be needed to replicate LMR's coverage.

Differing LMR and LTE system designs present additional transition hurdles. Major differences include:

	LMR	LTE
Tower elevation	High	Low
Power transmit	High	Low
Tower coverage	20–40 miles	1–3 miles
Tower antenna	Omnidirectional	Sectored (3x120°)
Handset power	High (5–100 W)	Low (200 MW)
Networks	Dumb networks	Smart networks
Setup	Set and forget	Dynamically modify for demand on as-needed basis
Indoor signal	Strong	Fair (today)
Bandwidth	Narrowband voice	Broadband data

As a consequence, a much higher density of LTE cell towers—as much as a 10X factor, depending on geography—will be required. This adds significantly to the deployment cost, despite the fact that LTE handsets (at

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$600–$1,000) should be far less expensive than their LMR counterparts (at $3,000–$10,000). In locations where hybrid (LMR+LTE) devices are required, the handset cost will remain high.

My fear as an LMR industry person is that funding will be taken away from LMR networks in anticipation of LTE. I encourage my clients to maintain a strong LMR footprint in the budgeting process.

Robert Shapiro

Although the public safety LTE network will be able to share many of the commercial LTE towers, it is not yet clear how service will be provided to rural areas that are currently uneconomical for AT&T, Verizon, and Sprint to support. The Forest Service, in particular, needs extensive remote coverage.

A proposed LTE broadband system for California's Santa Barbara County Fire Department, for example, specifies 62 sites to provide coverage comparable to the six existing LMR locations.

LTE will enable new public safety applications.

Just as iOS and Android have prompted a dynamic ecosystem of creative apps, LTE's arrival will encourage commercial developers to produce applications for public safety purposes.

Foremost among these will be video apps that help first responders do their jobs:

- **Helicopters.** Overhead helicopters could stream live landscape visuals to firefighters on the ground, for example.
- **Vehicles.** Today, many police cars are equipped with dashboard cameras to document all citizen interactions. Because the video is stored locally, however, it can take up to 12 hours for a criminal incident recording to reach investigators. With an automatic LTE upload, the recording could be available immediately.
- **Disasters.** Live video of a spreading chemical or biological plume will help hazmat teams organize evacuations. Similarly, tornado and hurricane monitoring can be in real time.

Just building the network and putting the same users on an IP network is not interoperability. We need applications to be able to share information.

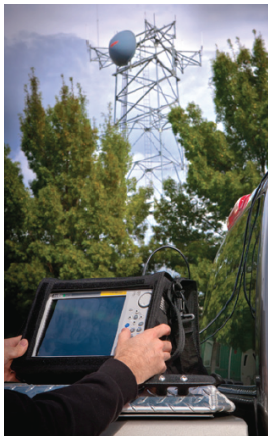
Joe Ross

With LMR's limited data capability, it has been difficult for public safety agencies to distribute their stored documents on demand. With LTE, responders will have ready access to building floor plans, criminal "rap sheets," vehicle records, high-resolution GIS maps,

and victim medical histories. By the same token, EMTs at accident scenes will be able to transmit richer patient information, such as ultrasound images, directly to hospitals, and police officers will be able to file field reports immediately.

There's going to be a boom of applications and services developed to provide public safety with solid access to all of their local data sources.

Andrew Thiessen



In the same way that no one could have predicted some current smartphone apps, the LTE public safety network is sure to generate surprisingly useful new applications. Accurate speech recognition, for example, suggests numerous opportunities for innovation. The FBI is experimenting with a tool that lets field agents transmit a suspected child abductee's photo, which the central system then "ages," compares with its reference photos, and returns a percentage probability that the subject has been accurately identified.

FirstNet, a government-chartered entity, will build a national broadband network for public safety agencies.

In February 2012, the Middle Class Tax Relief and Job Creation Act of 2012 was signed into law. It includes a section that provides financing for the First Responder Network Authority (FirstNet).

Title VI

Public Safety Communications and Electromagnetic Spectrum Auctions

Sec. 6101-6703 – Spectrum Auction. This provision grants the FCC the authority to hold voluntary incentive auctions, allocates necessary spectrum for a nationwide interoperable broadband network for first responders, provides $7 billion for public safety broadband network build out, and provides up to $1.75 billion for relocation costs for broadcasters. This provision is estimated to raise $15 billion over the next eleven years.

FirstNet will work with state, municipal, and tribal governments to assess and deliver their public safety network needs. Since FirstNet is essentially in competition with commercial LTE networks and existing LMR systems, it must provide the features and benefits that first responders request. A potential issue: because individual states can opt out of the

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system, no nationwide network is possible unless FirstNet convinces everyone.

One possible direction being considered is to partner with utilities, railroads, and other entities to share the cost of the build-out in return for access to the LTE network for household power monitoring, for example, and other applications.

There are still too many unknowns surrounding FirstNet to know exactly where we are right now.

Andrew Seybold

FirstNet's just-appointed 15-member board includes four public safety representatives; the majority are current or retired telecommunications executives. One significant appointment is the CEO of the National Rural Telecommunications Cooperative.

A 2004–2005 demonstration pilot in the Washington, DC area run by the Department of Commerce's Public Safety Communications Research Group showed that the test 700 MHz system—OFDM, an LTE predecessor technology—was robust in operational reliability but weak in indoor penetration, edge-of-cell signal strength, and video uplinking.

Resources

For additional information on Land Mobile Radio testing for P25+LTE, visit Anritsu at www.anritsu.com or contact Anritsu at +1-800-ANRITSU.

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Joe Ross
Partner
Televate LLC

As a technical executive, Joe has a strong background in wireless and public safety communications. His experience includes managing major public safety network deployments and operations and working for major cellular telephone companies. Joe's accomplishments include leading the first initiatives to call for broadband for public safety at 700 MHz and implementing the nation's first and only broadband 700 MHz public safety networks. His current goal is to develop and implement a national broadband wireless network and applications for public safety that provide the right information at the right time and within the financial means of government.

Andrew Seybold
CEO and Principal Analyst
Andrew Seybold Inc.

Andrew M. Seybold, CEO and Principal Analyst of Andrew Seybold, Inc., is one of the most respected and influential analysts in the wireless industry today. For more than twenty-five years, he has served the industry and shaped initiatives for world leaders of the wireless industry, including Verizon, Nokia, AT&T, Motorola, and Qualcomm. His firm has provided wireless consulting and education services for startups to Fortune 1000 companies such as Dow Chemical, Ford Motor Company, and Microsoft.

Robert Shapiro
Independent LMR Consultant

Robert is a seasoned wireless professional with over 25 years of technical and management experience with expertise in RF engineering in a simulcast environment. His technical specialties include all aspects of the wireless and RF engineering ecosystem such as radio coverage, site development, antenna systems, and project management. Robert also has expertise in technical solutions marketing and standards processing. Robert holds a master's of business administration from the University of Dallas, Irving, Texas as well as bachelor degrees in business administration and electrical engineering.

Andrew Thiessen
Standards and Requirements Lead, Public Safety Communications Research (PSCR), US Department of Commerce

Andrew Thiessen is the Lead for Public Safety Communication Standards, Requirements, and Compliance Assessment for the Institute for Telecommunication Sciences (ITS), in the National Telecommunications and Information Administration, Department of Commerce. His work is part of a joint effort between ITS and the NIST Office of Law Enforcement Standards (NIST/OLES) named the Public Safety Communications Research (PSCR) program. Andrew is the Project 25 Compliance Assessment Program (P25 CAP) Laboratory Program Manager. As such, he is responsible for the assessment process as it pertains to the P25 CAP. Andrew is also the chair of the APCO Project 25 Interface Committee (APIC) Broadband Working Group (4.9GHz), Vice-Chair of the National Public Safety Telecommunications Council (NPSTC) Technology Committee, co-chair of the NPSTC Broadband Working Group (700MHz). Andrew holds a Bachelor's degree in electrical engineering for Worcester Polytechnic Institute (WPI), a Bachelor's degree in English, also from WPI, and a Master's degree in electrical engineering from Stanford University.