



WHITE PAPER

Bolstering Public Safety with 4G LTE Technology

Mobile 4G LTE Routers Enable Commercial Carriers to Maximize Benefits to Public Safety Agencies and First Responders



Executive Summary

A bridge strategy for future integration with the FirstNet Band 14 network

Congress initiated the First Responder Network Authority (FirstNet) in 2012 in response to the need for better communications to support public safety in the United States. As part of this effort, FirstNet defined a 4G LTE Band 14 network to provide reliable, high-speed, critical, and secured communications for first responders who serve the nation's communities. This private, nationwide network will roll out over the next 7 years.

As a bridge strategy, regional cellular carriers can begin serving first responders now by

providing fast, reliable 4G LTE broadband services for mission-critical applications via commercial networks. By using flexible, configurable in-vehicle LTE equipment, public safety agencies can share information and access applications at broadband speeds at times when lives and property may be at risk. Specialized mobile routers, like BEC Technologies' MX-1000, can also provide real-time network performance data when combined with the BEC LCMS (LTE Cloud-based Management System), to help cellular carriers monitor and manage their networks—all while serving the public's safety needs.

This paper explores how FirstNet creates an opportunity for carriers to enhance services that support local public safety agencies and first responders by using equipment specifically designed for mission-critical operations, and how the MX-1000 can become the basis of a bridge strategy for future integration with the FirstNet Band 14 network.

The FirstNet Vision: B14

A Nationwide, Dedicated Broadband Network

First responders, whether law enforcement, firefighters, or EMS personnel, constantly live on high alert, whether battling the forces of nature that devastate entire regions—fires, flooding, wind, and earthquakes—or putting themselves in the line of fire as part of their normal duties. First responders must be prepared when approaching a new situation, whether in times of crisis or during a seemingly routine traffic stop. They must be able to instantly access mission critical broadband information, such as biometrics, criminal histories, and property images, for their own safety and for the safety of others. First responders also need to be able to send information, images, and streaming video to central command and to other agencies for support and analysis. Accessing these types of applications from their vehicle requires their vehicle to have broadband communications capability.

Currently first responders rely on Land Mobile Radio (LMR) for voice communications. LMR provides a secure network to first responders; however agencies are often on different networks. When multiple agencies are gathered at an emergency scene, they need the ability to seamlessly communicate with each other, instead of having to route communications through one or more central stations. Another problem with LMR communications is that it cannot be used to access applications, search databases, or share video. First responders often have to rely on personal smartphones to share data and access applications. Unfortunately, public networks are vulnerable to outages or delays due to extreme weather or heavy congestion on the network, which tends to peak during critical communications events. Excess network traffic sometimes occurs during crowded public events, like political rallies or sporting events, or when “voting” occurs on reality shows. Network

congestion and outages affect all calls, even emergency communications from first responders. Clearly public safety agencies need priority access on secure, dedicated voice and data networks that can reliably offer high speed and availability.

In response to this need, Congress created the First Responder Network Authority (FirstNet) in 2012. FirstNet created a nationwide initiative to deploy 4G LTE on a network dedicated to public safety. This network is located in the 700 Megahertz frequency allocation known as Band 14. This band provides public safety agencies and first responders with all the benefits of 4G LTE broadband, without the natural congestion of a publically accessible network.

With Band 14, the following scenarios can become reality, nationwide: ¹

- Fire departments can download building plans to handheld devices
- Police helicopter provides video downlinks to incident commander
- EMS transmits patient information, including video, to hospitals
- Incident communication unit leader establishes interoperable talk groups for state and local responders
- Responders arriving from surrounding jurisdictions are seamlessly integrated
- The network continues to work, even when cellular is overwhelmed by civilian traffic

The burden of deploying Band 14 across the country falls on local municipalities and cellular carriers. The target date for the Band 14 network is 2022, though this will vary depending on the financial resources and technical abilities of each municipality.

Early Deployers of FirstNet

The LA-RICS and the city of Charlotte, NC

Municipalities around the United States are beginning to implement FirstNet Band 14. The road to deployment has not been smooth. Early adopters face multiple obstacles such as funding and regional cooperation. The Los Angeles Regional Interoperable Communications System (LA-RICS) and the city of Charlotte, North Carolina, are examples of municipalities that are approaching FirstNet deployments with different strategies and experiencing different challenges.

LA-RICS is using Broadband Technology Opportunities Program (BTOP) grant funding, from FirstNet, to build and deploy a private, 4G LTE Band 14 network. Mid-deployment, LA-RICS was forced to halt the program when some cities in the region pulled their support because of concerns over radio tower heights and locations. Ultimately the project got back on track when the agency modified the plan to replace many of the fixed towers with mobile cellular units on wheels. Since then, FirstNet granted a 5-year extension for LA-RICS to complete the program.



The city of Charlotte tried to use a BTOP grant, but was not able to reach an agreement for wireless spectrum management, a requirement for BTOP monies. Because of this, Charlotte needed to find another path to LTE deployment.² The city found its answer by working with commercial carriers to utilize an existing commercial 4G LTE network that gives responders the ability to use high-end applications, such as GIS mapping systems and crime analytics programs that are problematic on the slower speeds provided by non LTE based solution. Their new network is installed on 950 public safety vehicles, and is available to 42 fire stations, and 14 police divisions.

A drawback to Charlotte's solution is that unlike cities with a dedicated Band 14 private network, Charlotte cannot prioritize network traffic. This puts first responder communications in direct competition with all of the other communications on the network. The city addresses this issue by using dual-SIM/dual-radio devices to enable network failover. Failover means that if one cellular network is no longer available or highly congested, the router can switch to a different cellular network providing the flexibility to use the most available network for first responder communications. Once Band 14 is in place, one SIM will provide access to the commercial network and the other to Band 14. This approach provides the benefits of broadband today while providing a bridge to Band 14 as it becomes available.

Enabling the 4G LTE Network

Band 14-enabled devices, the most important element to public safety

To ensure high-speed voice and data communications, FirstNet requires that public safety broadband networks incorporate all the elements of a 4G LTE network. This includes: an Evolved Packet Core (EPC), a transport layer for backhaul, a radio access network (RAN) that uses enhanced base stations (eNodeB) for 4G LTE speeds, and devices that can operate within the Band 14 spectrum.

FirstNet, in its LTE Overview presentation ³, lists Band 14-enabled devices as “the most important element to public safety.” Rugged, location-enabled devices that support Band 14 are critical for first responders to tap into the benefits of a broadband network. From portables like smartphones and tablets, to in-vehicle routers and specialized equipment like drones and rovers, devices are first responders’ touchpoints to the RAN.

Dual-SIM, dual-radio in-vehicle 4G LTE routers are key to enabling agency use of bandwidth-intensive systems and applications immediately on 4G LTE commercial networks then easily switching to the Band 14 network as it becomes available.

Not all routers are alike. There are several key features that should be considered when selecting mobile routers to access high-speed public safety networks. Must-haves include:

- **Dual SIMs, Dual Radio** – Dual SIMs and dual radios support seamless carrier failover. By enabling two WANs, public safety agencies can use one for the commercial carrier network and, later, one for Band 14. And when FirstNet is deployed, the commercial network becomes a failover to the commercial network if the Band 14 network experiences problems.
- **Multi-service selection** – Multiple APNs let agencies set up dedicated bearers for specialized services like video, messaging, and broadcasting.
- **Wi-Fi and Ethernet Access, with multiple SSIDs** – The router serves as a mobile Wi-Fi hotspot, enabling broadband support to first responder devices. Multiple SSIDs will enable agencies to set up “guest” access on their networks, allowing other agencies and civilians to use the hotspot for their own devices. This keeps public access separate from secured agency communications. It also enables public service agencies to use lower cost Wi-Fi devices rather than requiring all devices to be LTE enabled.
- **Fast upload/download capacity** – These routers provide mobile hotspots, enabling multiple first responders and other emergency personnel to link to the Band 14 network at uplink speeds of 50 Mbps, and downlink speeds of up to 300 Mbps on Category 6 devices (up to 100 Mbps for Category 5 devices).
- **High performance GPS** – Accuracy is of utmost importance for location-based services and applications. Routers must have reliable, built-in GPS capability.
- **Ruggedized for harsh conditions** – Emergencies occur in all types of weather. An in-vehicle router must withstand a wide range of temperatures and conditions. Routers must be able to withstand and operate when exposed to wind, water, dust, and vibrations. Unlike stationary applications, routers installed in vehicles must also be able to safely operate within the harsh electronics of 12 Volt battery-based ignition systems, harmonics, and continual on/off operations.

BEC MX-1000

The MX-1000 in-vehicle 4G/LTE router, from BEC Technologies, meets and exceeds all of these requirements and more, supporting voice, video and data communications. By deploying the MX-1000 router with their network services, regional carriers can serve all their constituents—paramedics, police, fire, ambulance, (electric, water, gas) utility workers, FEMA, homeland security and more. This ruggedized, mobile router benefits first responders' operations by providing proven technology to link to LTE networks that support digital imaging, video streaming, database lookups, video/surveillance feeds and other data-intensive capabilities that traditional narrowband networks and LMR cannot support. The MX-1000 is available today and works with any regional and roaming U.S. commercial carrier. It also supports dual SIM and can use up to two separate communications modules that can be upgraded as new mobile communications frequencies come available.

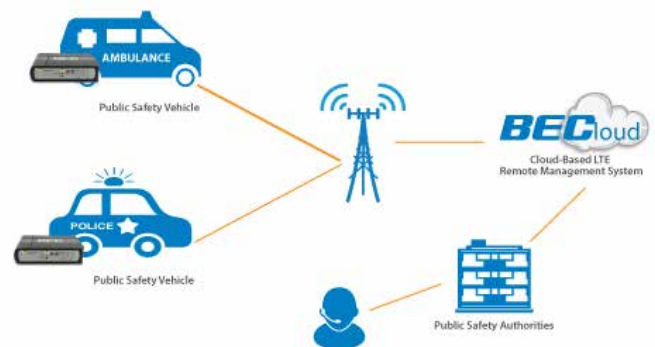


MX-1000 Front



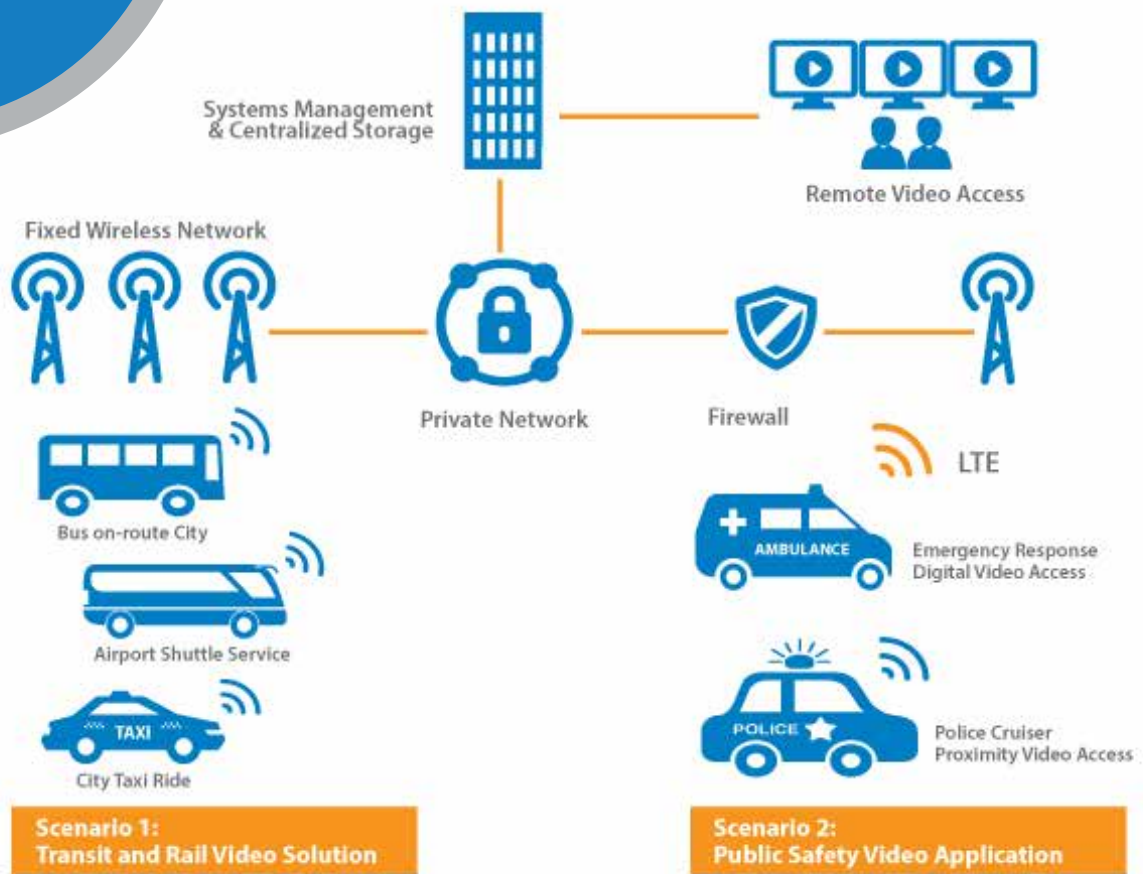
MX-1000 Back

The MX-1000 was designed specifically to support high-bandwidth, mission-critical functions such as database lookups, dispatch messaging, mug shots, video/surveillance feeds, broadcasting, medical data transmission, and more on LTE. It is MIL-STD 810G certified, meaning its hardened enclosure and industrial grade components allow it to operate in the most challenging conditions, even when exposed to heat, humidity, shock, and vibration.



BEC MX-1000 Public Safety Diagram

BEC MX-1000



Other legacy routers had cumbersome power on and power off procedures, while the MX-1000 uses BEC's Intelligent Ignition Sensing (ISS) to automatically turn the router on when the ignition is switched on, and gracefully power down the router when the ignition is switched off. This protects the equipment, increases the life of the router, and eliminates time consuming steps for first responders. With ISS, first responders can get into their vehicles with confidence that their mobile hotspot is available and ready to use.

Deployments of BEC's MX-1000 are currently underway. By deploying the MX-1000 municipalities can reap the benefits of 4G LTE immediately, supporting the needs of the 21st century first responders. With 4G LTE their response teams gain the ability to access mission critical broadband data at any point within the route to, from, and at the scene of the emergency; gain access to GPS for track and trace; and have a mobile Wi-Fi hotspot allowing multiple devices to securely access the Internet from the vehicle.

By Providing A Bridge Strategy

Benefits of a Broadband Public Safety Network

Both carriers and municipalities can benefit from a joint approach to deploying LTE for public safety. The path to a nationally available private network for public safety is not easy, as seen with the challenges that early movers experienced. Many municipalities don't have experience with cellular technology and don't know where to start. This presents an opportunity for commercial carriers to enhance their relationship with these municipalities by providing a bridge strategy to enable their customers, the municipalities, to deploy 4G LTE to public safety agencies now, in advance of a Band 14 nationwide deployment.

By providing expertise, broadband services, and specialized equipment to deploy LTE public safety networks, carriers can help municipalities test and deploy new technologies quickly. With access to broadband speeds, public safety agencies can develop new workflows and procedures to incorporate efficient use of large bandwidth technology within their normal operations, providing bandwidth-intensive applications that first responders can access from their vehicles.

By providing access to portions of existing network infrastructure and spectrum, carriers can also

help their customers by reducing a municipality's cost to deploy all new infrastructure as they implement Band 14 in their region, regardless of whether the municipality has a BTOP grant or is using local funds to build out Band 14.

Commercial carriers may also benefit by working directly with FirstNet. Small, rural carriers provide an attractive opportunity for FirstNet to widen and deepen coverage in underserved areas. In return, excess Band 14 spectrum may provide an opportunity for regional carriers to roam on FirstNet's network.⁴

By deploying BEC MX-1000

Benefits Beyond Band 14

The benefits of the MX-1000 to municipalities extend beyond providing broadband access. Public safety agencies can use the optional fleet management application to allow them to manage their assets, as well as to support operational efficiencies, by:

- **Reducing response times**
 - GPS mapping provides the location of all vehicles equipped with the MX-1000. This information can be used to ensure the nearest available vehicle gets routed to respond to a call for help.
- **Improving evidentiary records** – GPS information can be tied to video footage,

providing critical data that addresses criminal court recording requirements.

- **Reducing vehicle downtime**
 - The MX-1000 integrates with in vehicle OBD II systems and allows centralized reporting and tracking of vehicle health monitoring and driving conditions. By monitoring vehicle fault diagnostics and mileage, preventative maintenance can be scheduled and issues uncovered through engine diagnostic codes can be addressed when convenient for the fleet. This reduces unscheduled vehicle downtime; keeping fleets in working order and controlling

maintenance costs

- **Managing assets through geo-fencing and GPS mapping** – Agencies can monitor and reduce personal use of municipal vehicles, reducing fuel costs and unnecessary wear and tear. Geo-fencing sends notifications when vehicles and equipment leave authorized areas, helpful in dangerous situations if first responders haven't checked in as expected.
- The fleet management application uses an easy-to-install OBD-II device that works with most passenger vehicles equipped for emergency use.

Cloud-Based System Ease Deployment

LTE Cloud-based Management System(LCMS)

All this new technology, if deployed using traditional methods, could be cost prohibitive to many municipalities. BEC took this into consideration when developing their LCMS (LTE Cloud-based Management System). LCMS uses cloud-based technology to provide comprehensive, real-time device management services, without need for an expensive IT infrastructure.

The BEC LCMS provides all of the typical features and functions available in most customer support portals, such as DHCP server configuration, ability to configure CPE functions, provisioning, device management, firmware over the air (FOTA) updates, remote reboot and reset, etc. In addition, the BEC LCMS provides a unique feature for carriers: network performance data. Whether used on a private or commercial network,

By gathering and analyzing network statistics from the BEC LCMS, carriers can improve their network's performance, monitor the network, and diagnose problems—a benefit for both public safety and commercial networks. In the past, this performance and device data required people in the field with specialized test equipment to manually gather network performance data. Using the BEC LCMS reduces this cost and provides the data in real-time. No more waiting for field test reports to come in. Carriers can proactively use this data to monitor and improve their networks, resulting in better service for all of their customers.

BEC provides:

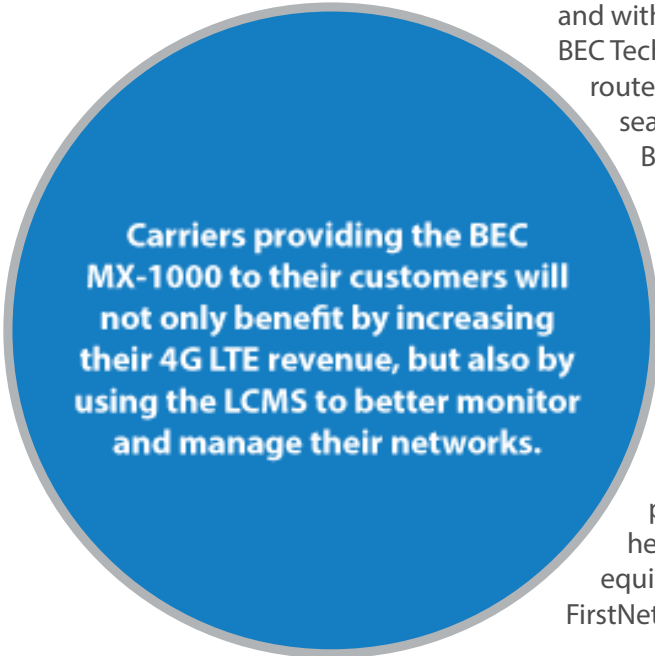
- **Real-time signal quality measurements** – Signal quality data can be analyzed over time or users can configure alerts based on signal strength thresholds, allowing for immediate notification if signal quality drops.
- **Signal quality timeline chart** – Automatic reports on signal strength measured in 30 minute intervals that can be used for analysis and network improvements.
- **LTE signal performance at a glance** – Provides the ability to view and assess LTE performance for each vehicle. This may provide early warning to carriers for potential problems in their 4G network.
- **Network traffic analysis and bandwidth monitoring** – Provides traffic information to carriers, helping them understand where new towers or infrastructure may be needed to support their customers.
- **Reduced cost of network monitoring** – Real-time data from the LCMS may mean fewer field testers on the road.



BEC LCMS Log-in Interface

Conclusion

A Seamless Transition to Band 14



Carriers providing the BEC MX-1000 to their customers will not only benefit by increasing their 4G LTE revenue, but also by using the LCMS to better monitor and manage their networks.

FirstNet's 4G LTE Band 14 network promises significant improvements to first responder communication systems over use of traditional LMR systems only. The responsibility to build and deploy the Band 14 network largely falls on municipalities and public service agencies. Commercial carriers can assist with 4G LTE deployments in vehicles now and with the transition to Band 14 later by providing the BEC Technologies MX-1000 dual-SIM/dual radio mobile router. The dual SIM/dual radio feature provides a seamless transition to Band 14 by simply inserting a Band 14 enabled SIM card in regions where Band 14 is available. The other SIM card in the router can continue to access a commercial LTE network and act as failover in case the Band 14 network is not available.

Carriers providing the BEC MX-1000 to their customers will not only benefit by increasing their 4G LTE revenue, but also by using the LCMS to better monitor and manage their networks. A partnership between carriers and municipalities will help first responders access 4G LTE, becoming better equipped for today's emergencies as well as tomorrow's FirstNet Band 14 deployment.

To test drive the BEC LCMS, visit bectechnologies.net/portfolio_item/becloud/

For more information about the MX-1000, visit www.bectechnologies.net/portfolio_item/mx1000/

¹ *Understanding Mobile Broadband for Public Safety*, <http://www.sirn.wv.gov/>

² *Charlotte, NC., Launches Revamped Public Safety Communications Network*, Brian Heaton, June 4, 2015, www.govtech.com/network

³ *FirstNet LTE Overview*, <http://www.firstnet.gov/sites/default/files/LTE%20Overview-.pdf>

⁴ <http://www.fiercewireless.com/tech/story/cca-member-carriers-drive-suggestions-firstnet/2015-07-30>



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