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Push-To-Talk over Cellular:

The Flavors of PTToC

Carrier Integrated, Over the Top, and MCPTT

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The PTToC Landscape

The landscape for Push to Talk over Cellular (PTToC) has seen numerous changes over the past five years. With the exit of iDEN (the first flavor of PTT over Cellular from Nextel) from the U.S. market, wireless carriers and independent PTToC service operators have raced to capture the 20 million former Nextel subscribers. But while these PTToC providers are trying to gain market share, the LTE standard body known as the 3GPP recently issued a standard for what it refers to as Mission Critical PTT over LTE (MCCPTT). Unfortunately, the name applied to this standard is essentially an oxymoron since in order for any form of PTT to be considered Mission Critical over LTE, the LTE network itself must also be mission critical. Today's commercial networks provide "best effort" service and the new FirstNet LTE network will not initially be built to meet Mission Critical Standards. While Mission Critical PTT over LTE is not yet a reality and, in fact, the standard has not yet been implemented by any LTE network, there are still many vendors pursuing the PTToC market and many of them are promising their existing offerings will be modified or upgraded to comply with the MCCPTT standard over time. Meanwhile, let's take a look at today's flavors of PTT over Cellular. For ease of discussion we have divided the PTToC offerings into three distinct groups:

Carrier Integrated PTToC offerings from Verizon Wireless, AT&T, and Sprint are available in the United States. The benefit of the Carrier Integrated PTToC option is tight integration between the wireless network and PTToC system. They claim faster call setup times and better performance during periods of high network congestion. Over the Top PTT systems do not integrate in the same way and are wholly independent from the wireless carrier's infrastructure. Verizon and AT&T use a technology referred to as OMA-POC. Sprint's offering is based on a technology called Qchat that was originally developed by Qualcomm. Qchat and OMA-POC are not compatible with one another, so they cannot interoperate in any way. Though the OMA-POC systems deployed by both AT&T and Verizon are from the same vendor, the two carriers have not demonstrated a willingness to provide cross-network PTToC, a major advantage for Over the Top architectures below.

Over the Top (OTT) refers to an architecture where the PTT system is fully independent of the carrier's wireless networks. A properly designed OTT system can communicate over traditional wireless carrier networks (Verizon, AT&T, T-Mobile, Sprint, etc.) Wi-Fi networks (public or private), standard wired

networks (for PC clients), and private LTE networks, including FirstNet and Deployable systems. With Basic Over the Top systems, the carrier is simply the data transportation provider and is agnostic to the PTT system or network.

Advanced Over the Top (AOTT) combines the flexibility of OTT plus enhanced Quality of Service (QoS) provided by the wireless carriers. In the United States, both Verizon Wireless and AT&T Wireless have deployed QoS offerings for their business and government customers (the networks refer to this as priority access). Verizon's Private Network Traffic Management (PNTM) and AT&T's Dynamic Traffic Management (DTM) solutions allow PTT solution vendors to create advanced offerings that address one of the key issues associated with moving basic OTT toward mission critical or public safety grade. This paper will highlight the Advanced OTT architecture and features associated with one of the leading OTT solutions, Enterprise Secure Chat (ESChat).

In its pursuit to develop a Mission Critical PTToC solution for FirstNet, the Third-Generation Partnership Program (3GPP) developed a specification referred to as **MCPTT** as noted above. The 3GPP's MCPTT specification is based on the OMA-POC standard that is also used by Verizon and AT&T. The OMA-POC architecture is recognized as inefficient compared to more nimble OTT offerings because it becomes part of the network, and its design requires significant infrastructure elements to be installed on the network. Expectations are that the FirstNet LTE system will be sufficient to overcome the inefficiencies in the OMA-POC design. After all is said and done, MCPTT has been defined as the preferred architecture for PTToC on FirstNet. However, part of the premise of FirstNet is that public safety users will also be able to roam onto at least one other commercial network. If PTToC is not compatible between FirstNet and roaming on another LTE network it will hinder the useability of PTT over LTE.

The chart below is a comparison of the various types of PTToC detailed above. You will notice that MCPTT is lacking in a number of functions that are and have been offered by other PTToC vendors for a long time. The chart shows clearly that the current MCPTT standard is still network-based and therefore in order to provide cross-network PTToC the networks will have to be interconnected, which is something network operators are loathe to do. If the market for PTToC is to grow beyond its current niche status, interconnection across networks is an absolute requirement.

If you look back at voice over cellular, text messaging, and MMS messaging and plot the growth curves for all of them it becomes clear that the major user growth for each of these wireless communications

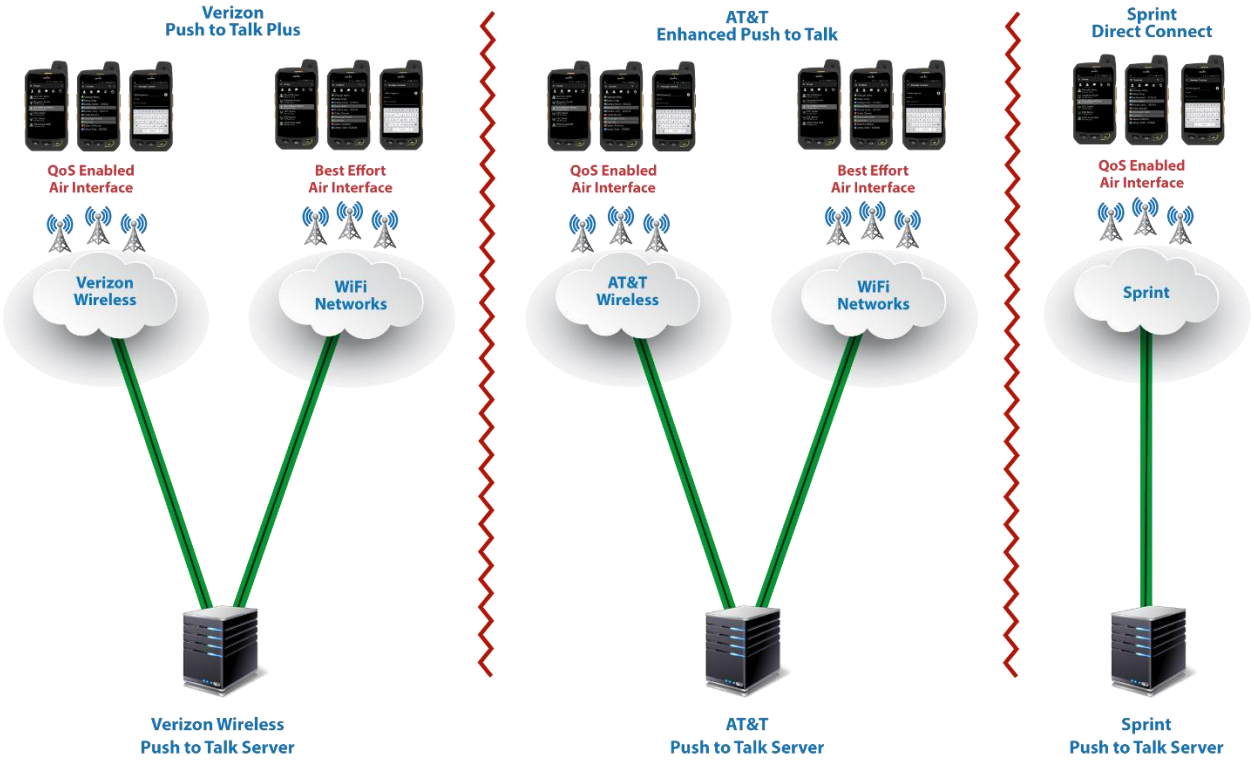
capabilities occurred only when they became available across networks. People and companies do not like to be tied to a technology that limits their choice of network. In many cases, organizations with offices in different cities and states may make use of different wireless carriers depending on the coverage in a given area.

Feature Matrix for PTToC Architectures

Call Type / Feature	Basic OTT	Advanced OTT	Carrier Integrated	MCPTT
Carrier Agnostic	✓	✓	✗	✗
Cross Carrier Communication	✓	✓	✗	✗
Quality of Service (QoS)	✗	✓	✓	✓
Cross Carrier Quality of Service (QoS)	✗	✓	✗	✗
Hosting Options				
- Cloud or Carrier Data Center	✓	✓	✓	✓
- Private Data Center (including Geo-Redundant)	✓	✓	✓	✓
- Customer Hosted / LMR Co-Located	✓	✓	✗	✓
- Deployable Network	✓	✓	✗	✓
- Deployable Off Network / Air-Gapped	✓	✓	✗	❖
Broadcast/Multicast	✗	❖	✗	❖
Degraded Network Operation	✗	❖	✗	❖
Direct Mode Communication	✗	❖	✗	❖

✓: Supported ✗: Not Supported ❖ Anticipated Future

Carrier Integrated PTT



In the United States, three of the four major carriers are currently offering Carrier Integrated PTT solutions (T-Mobile has shown no interest). Carrier Integrated solutions have the advantage of tight integration with the carrier network, and include key elements for reliable communications including enhanced QoS. Carrier offerings are limited in comparison with the Over the Top model, as the carriers only allow PTT operation on a limited set of the available smartphone and tablet devices. Some carriers do allow PTT operation over Wi-Fi but the over-the-air QoS advantage is not maintained on the Wi-Fi networks.

Carrier Integrated PTT solutions are designed to create the best business offering for the carrier itself, whereas Over the Top solutions are more flexible, support a broader set of features, and are designed with the end-customer in mind. Since each carrier would prefer PTT users to operate on their own wireless network, there is no business motivation for them to allow interoperability to the other networks. The clearest case of this is where Verizon Wireless and AT&T use the same PTT vendor (using

the same PTT technology) and yet users on Verizon Wireless and AT&T cannot communicate with each other.

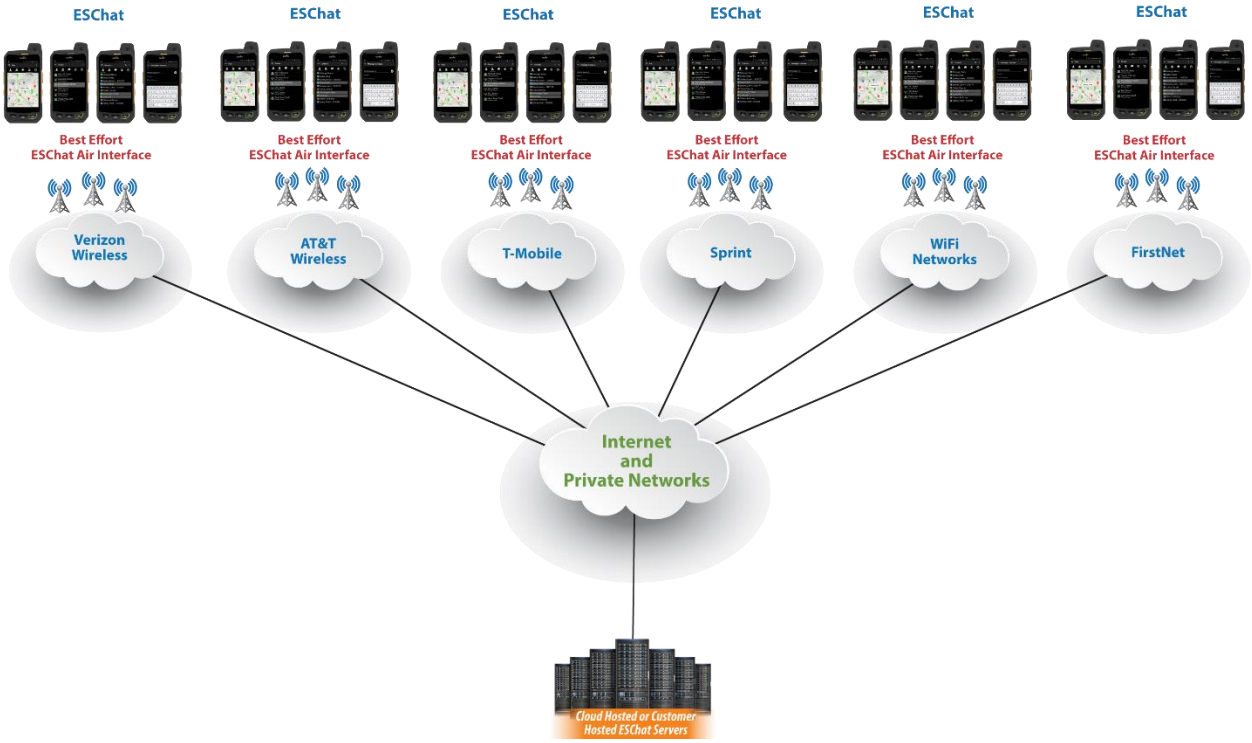
However, in 2016, AT&T did attempt to provide a method for Verizon customers to communicate with AT&T PTT users. AT&T created an Over the Top Android Client that was available to a single model of Verizon phone and downloadable through its Google Play storefront. PTT service was purchased through AT&T and did allow interoperability between the carriers. However, this hybrid approach could not offer QoS on the Verizon network. The offering was met with limited success and late in 2016 the Verizon phone reached its end-of-life and was removed from the market.

The devices used for PTToC as mentioned above are limited in number. One vendor that has gone all-in on devices for PTToC is Sonim Technologies. Sonim has embraced and implemented the key items required in a PTToC device, specifically:

- A dedicated push-to-talk button
- A speaker with sufficient volume for operation in high noise environments
- A speaker that faces the user
- A battery that will last a full day
- Dedicated accessories (headsets, ear pieces, remote PTT buttons)
- Ultra-rugged (Sonim's devices include a three-year unconditional warranty)

Sonim is the only PTToC handset vendor to include these key items and also support FirstNet's LTE Band 14. All said, PTToC remains a specialty or niche market so it is difficult to incent device suppliers to include these required items.

Basic Over the Top (OTT)



Lately in the battle over PTT technologies, proponents of Carrier Integrated PTT have been campaigning as though OTT is not even worth considering. My perspective is quite the opposite. Over the Top PTT implementations provide participating businesses and agencies the most flexibility and feature rich experience. They are network independent and work between networks so customers have much more flexibility in both network and device choices. Adding today's carrier-based QoS offerings (from Verizon Wireless and AT&T) to ***Basic Over the Top PTT*** systems, ***Carrier Integrated PTT*** systems are lackluster in comparison. Below are some of the characteristics associated with Basic Over the Top PTT.

Carrier Independent

Over the Top (OTT) refers to an architecture where the PTT system is fully independent of the carrier's wireless networks. A properly designed OTT system can communicate over traditional wireless carrier networks (Verizon, AT&T, T-Mobile, Sprint, etc.) Wi-Fi networks (public or private), standard wired networks (for PC clients), and private LTE networks, including FirstNet and Deployable systems. With Basic Over the Top systems, the carrier is simply the data transportation provider and is agnostic to the PTT system or network.

Cross Network Communication

Over the Top Push to Talk systems are not subject to restrictions imposed by wireless carriers on their own PTT offerings. As such, Over the Top PTT users can span across many networks. Therefore, a large business can select the wireless carrier that provides the best coverage in each given region. Businesses benefit by gaining the best wireless coverage in each of their operating areas. User training and customer support processes also benefit as only a single set of training and support materials needs be managed. Today, T-Mobile does not offer PTToC services yet with OTT PTT T-Mobile customers now have the ability to make use of PTT services. Employees that move between regions (and wireless carriers) do not need to be re-created onto a second Carrier Integrated PTT solution, rather all users are part of a consolidated PTT system.

Security

Over the Top systems are able to provide end-to-end strong encryption between mobile devices operating across multiple carriers. In this case, the OTT providers themselves are acting as the 'carrier' and are required to adhere to CALEA laws as they relate to lawful intercept (wiretap) orders.

ESChat Service Hosting

ESChat service is hosted from the Amazon AWS Standard and GovCloud environments. Customers also have the option to host their ESChat service in their own private cloud or internal network servers.

ESChat customers on the AWS Standard Cloud take advantage of service availability from any of Amazon's 42 'Availability Zones' within 16 geographic regions around the world and with more coming. For redundancy, each Amazon region is split into geographic Availability Zones that are 100% isolated from one another to ensure continued operation in the event of any failure. The ESChat servers maintain an active-active disaster recovery architecture across the Availability Zones, so in the event of a network failure, ESChat services will continue without interruption to the customer.

AWS GovCloud (U.S.) is an isolated AWS Region designed to allow U.S. government agencies and customers to move sensitive workloads into the cloud by addressing their specific regulatory and compliance requirements. The AWS GovCloud region adheres to U.S. International Traffic in Arms Regulations (ITAR) requirements. Workloads can contain all categories of Controlled Unclassified Information (CUI) data and government-oriented publicly available data in the AWS GovCloud region.

The AWS GovCloud region supports the management of regulated data by offering the following features:

- Restricting physical and logical administrative access to U.S. persons only
- Providing FIPS 140-2 validated endpoints

ESChat customers that choose to host their own networks can elect to build advanced architectures to support high availability operations and redundancy or low-cost non-redundant servers where high availability is not a priority.

Private Server Hosting

Customers often have a desire or requirement to host the PTT servers in their own facility. There are a number of reasons for this, including:

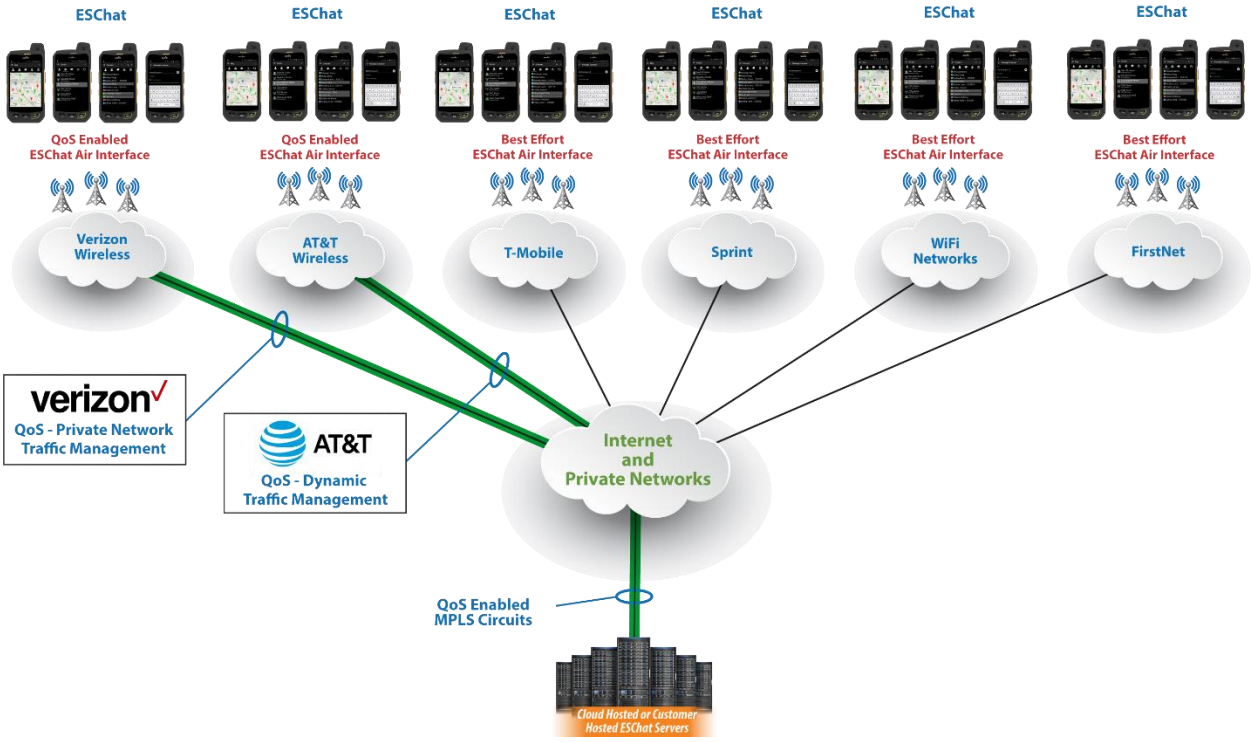
Enhanced Security: Assurance that non-authorized users cannot access the PTT network.

Off-Network Ops: Customers running private or deployable wireless networks can operate a private PTT system that is completely isolated from other users and fully air-gapped from the Internet. Some organizations feel this method of operation provides the best of both worlds, the ability to employ PTToC while at the same time remaining totally isolated from the threat of disruption due to an Internet breach of some kind.

Co-Location with LMR: Businesses and agencies that operate their own LMR networks typically have the available infrastructure to add an OTT PTT system. Co-locating the LMR and OTT PTT server provides additional advantages when connecting the two networks to create a hybrid LMR/LTE PTT system. This is especially helpful for P25 and Digital Mobile Radio (DMR) digital systems interfaces.

ESChat network management is performed through a web-based administrative portal. ESChat customers can augment network management by interfacing with other business systems through ESChat web service APIs.

Advanced Over the Top (OTT)



Quality of Service

One feature that has traditionally been included with Carrier Based PTT offerings is enhanced Quality of Service (QoS). In Basic OTT deployments, network data is allocated to the mobile devices on a 'Best Effort' basis. The wireless network attempts to provide an equal experience to all mobile devices. Using enhanced QoS profiles, carriers can offer improved data access to their own PTT users. This feature was required during the 2G and 3G days, but in the world of 4G LTE QoS offerings are not required for most users. However, there are situations where enhanced QoS is desired or even required.

Poor Network Coverage: For users operating in areas with limited LTE coverage, enhanced QoS can help provide a better communication experience. While QoS does not change the LTE coverage footprint, PTT users operating in areas of poor coverage experience somewhat better access to the LTE network. This is often enough to allow them to communicate where they otherwise could not. QoS is especially helpful at cell edges where typically signals are weakest and data rates are slowest.

Saturated Networks: More and more we see organized events such as concerts, parades, and sporting events where smartphone users capture still or video images and post or live stream to social networks. Scenarios where there is an increased number of users in a region and those users are sending large amounts of data to the LTE network are ripe for a diminished communication experience for both PTT and normal voice calls. The amount of capacity during these events is limited by the number of cell sectors that serve the venue and network access is determined by requests made by devices to the network. In some cases, the number of devices vying for access to the network can swamp the system in a confined area.

In the case of public safety or business-critical communications, enhanced QoS becomes a key issue. During natural disasters, LTE networks can also become saturated when wireless users access the LTE network to communicate with family or obtain informational updates. Many times, the press covering the disaster grabs a connection to the network and hangs onto it during the entire life of the event. During these occurrences, first responders cannot rely on best-effort QoS for reliable communications, so a more effective method of assuring access is needed.

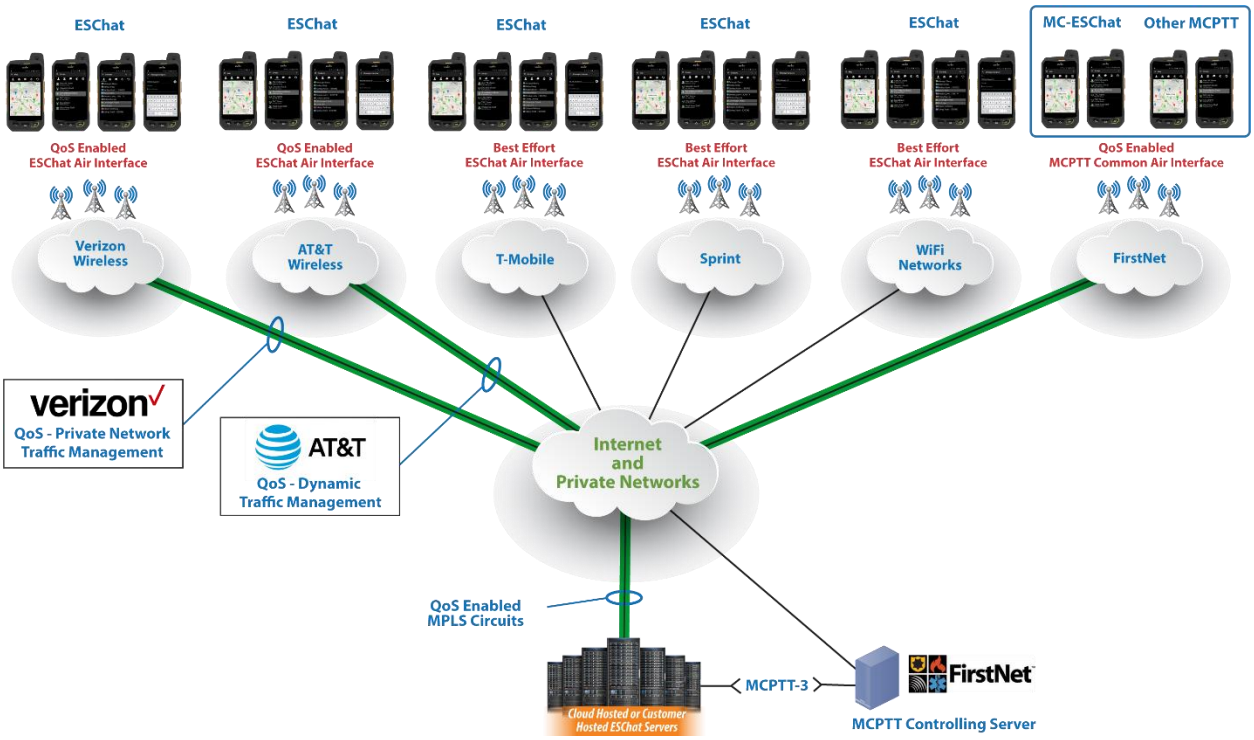
Carrier Enhanced QoS for Business Critical and Public Safety Users

To overcome these situations, some wireless carriers have begun offering an upgraded service package to provide enhanced QoS to their customers. In the United States, both Verizon Wireless and AT&T Wireless have rolled out enhanced QoS service offerings. Verizon's Private Traffic Network Management (PTNM) and AT&T's Dynamic Traffic Management (DTM) each offer customers multiple tiers for enhanced QoS. Each carrier offers enhanced QoS for business users and also for public safety users. There are two levels of QoS presently being offered. In the first case, a device is connected to the network's data stream has a higher level of priority across the network. In the second case, generally reserved for the public safety community, the QoS level is extended to access to the network. However, as described above, if a cell sector's signaling channel is overloaded, no matter what level of QoS has been assigned the network will not be aware of the connection request so it will not be able to gauge the QoS level of the device.

The Result: Over the Top PTT with Enhanced QoS

Leveraging the QoS options from the carriers, OTT service providers such as ESChat are able to provide all the benefits of OTT plus QoS for customers whose mission requires priority on the LTE network. This hybrid approach offers the most flexible and best performing PTT experience and is the only option available to provide cross-carrier PTT communications with QoS enabled on multiple networks.

Mission Critical Push to Talk (MCPTT)



To fulfill the need of public safety users planning to transition PTT voice communications from LMR to LTE over FirstNet, the 3GPP established standards for Mission Critical Push to Talk over LTE (MCPTT). The objective of the MCPTT standards is to ensure that the mission critical features included in LMR networks are also included in next-generation PTT over LTE systems. However, a standard for MCPTT will not truly provide Mission Critical or Public Safety Grade PTT service over LTE unless the LTE network it is running on has been built or upgraded to meet the Public Safety Grade standards developed by the National Public Safety Telecommunications Council (NPSTC). It not clear at this this point whether FirstNet's network will initially meet that definition, but perhaps it will over time.

The main challenge is that LMR networks are purposefully designed to provide one thing—lightning fast and reliable narrowband PTT voice communications. LTE networks were designed to provide general-purpose broadband connectivity for multi-media communication. Re-factoring the LTE network so MCPTT communication is similar to today's LMR experience is a significant task.

In order to create a Mission Critical Push to Talk over LTE solution, a number of areas need to be addressed. The MCPTT effort is not simply a software solution, but will require new technologies, chipsets, handset devices, and accessories as well. This transition is also complicated by the need to provide a graceful transition from LMR and will require seamless interoperability between the LMR and LTE networks. Industry groups are providing inputs to 3GPP to ensure that their needs are included when specifications to address these interoperability issues are standardized. Most importantly, off-network, or what is referred to as 'simplex' or 'talk-around', is an absolute requirement for the public safety community. It is not clear that MCPTT using the ProSe standard for off-network communications will be able to provide the same level of off-network service as LMR systems today.

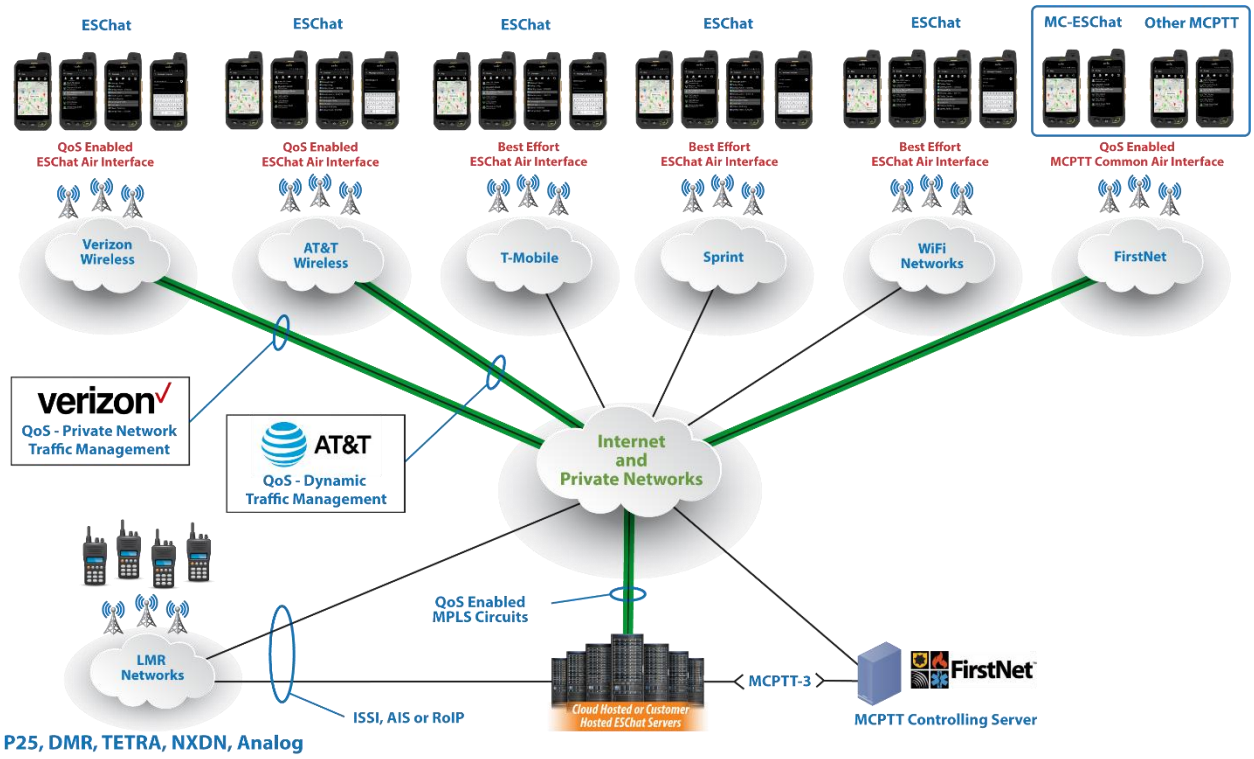
The big-ticket items required to fill the gap between today's advanced LMR networks and next-generation MCPTT are:

Quality of Service (QoS):	The ability to provide differentiated services to ensure that MCPTT users have sufficient bandwidth for reliable and quality communication.
Multicast Capabilities:	The ability for multiple MCPTT users to share the same LTE channel. This feature provides the greatest improvement in system efficiency and will be required as FirstNet begins adding a substantial number of subscribers.
Degraded Network Operations:	Degraded operations will allow a cell site that has been cut off from the rest of the network to provide localized communication to users within its coverage area. This type of graceful degradation is currently one of the most important features found within LMR networks.
Direct Communication Mode:	With a complete loss of LTE network connectivity, or the need to communicate between personnel at the scene of an incident without burdening the LTE network, MCPTT users must be able to communicate in a direct device-to-device mode (simplex or talk-around).

Other priority objectives addressed by MCPTT include ensuring no single vendor has proprietary claim to technology elements or shall be due royalties for use of technology. Further, no compliant vendor is locked out from operating on the MCPTT network and it is required that different vendors can interoperate with each other. 3GPP identified a common air interface in a manner similar to the P25 and DMR radio networks, where radios from vendor 'A' can communicate with a radio infrastructure from vendor 'B'. To support mutual-aid scenarios, 3GPP included a server-to-server interface (MCPTT-3) that enables users from other PTT networks to operate with users from the MCPTT network.

In order to meet the needs of the existing ESChat first responder customer base, ESChat is updating its product line to be fully 3GPP MCPTT compatible. The new offering, named MC-ESChat, will maintain its primary and full-featured operation on the QoS-enabled commercial carrier networks. However, MC-ESChat users will also be able to roam onto a FirstNet system and act as a fully compliant MCPTT client with the addition of all the vertical features not included in MCPTT (live location tracking, messaging, etc.). This is the type of upgrade to its PTToC service ESChat has been providing its customers through the system enhancements it has already rolled out and this new effort will serve to future-proof ESChat for both existing and new customers.

LMR Integration



LMR to LTE interoperation for MCPTT networks

The transition from LMR to LTE-based PTT technologies is anticipated to take many years. It is therefore critical that during the transition the two systems interoperate to ensure LMR and LTE users can communicate with one another. Land Mobile Radio systems will only begin to be replaced when the public safety community comes to trust PTToC with its own lives. This may seem like an overstatement but it is not since PTT communications can be the only form of communications available to notify others of an officer in trouble, shots fired, or other incident that puts life in peril.

LMR to LTE interoperation for Non-MCPTT networks

The integration of LTE and LMR opens a wide range of options for users. Some reasons to integrate LMR and LTE PTT systems include:

- Adding capacity to an LMR network without adding LMR infrastructure
- Extending the coverage area of an LMR network beyond its typical local coverage area

- Unifying PTT communication from numerous LMR networks. PTToC on the FirstNet system can and will be employed during incidents that require communications across different disciplines (law, fire, EMS) as well as when other jurisdictions whose LMR radios may not be compatible with those at the scene are called. FirstNet becomes first and foremost the main form of true interoperability between agencies.
- Providing a means for command staff to monitor and communicate while out of LMR coverage and or to be included in the incident planning and decision-making process.
- Providing the ability to carry a single device where non-mission-critical communication is required.

Radio over Internet Protocol (RoIP)

The most basic form of LMR to LTE interoperability is referred to as Radio over Internet Protocol (RoIP). RoIP provides a simple, reliable, and low cost option for integrating LMR and LTE networks. However, there are limitations to the capabilities of RoIP, for example, it does not support private calling and the passing of device IDs between networks. RoIP systems typically rely on a donor radio for access to the LMR system (cross connecting LMR and LTE networks). The advantage to the donor radio approach is that any radio technology (P25, DMR, TETRA, NXDN, analog, etc.) can be supported. However, these systems require one donor radio for each LMR radio channel to be shared, which can make for a 'clunky' system when numerous channels are needed to provide interoperability.

P25 via ISSI

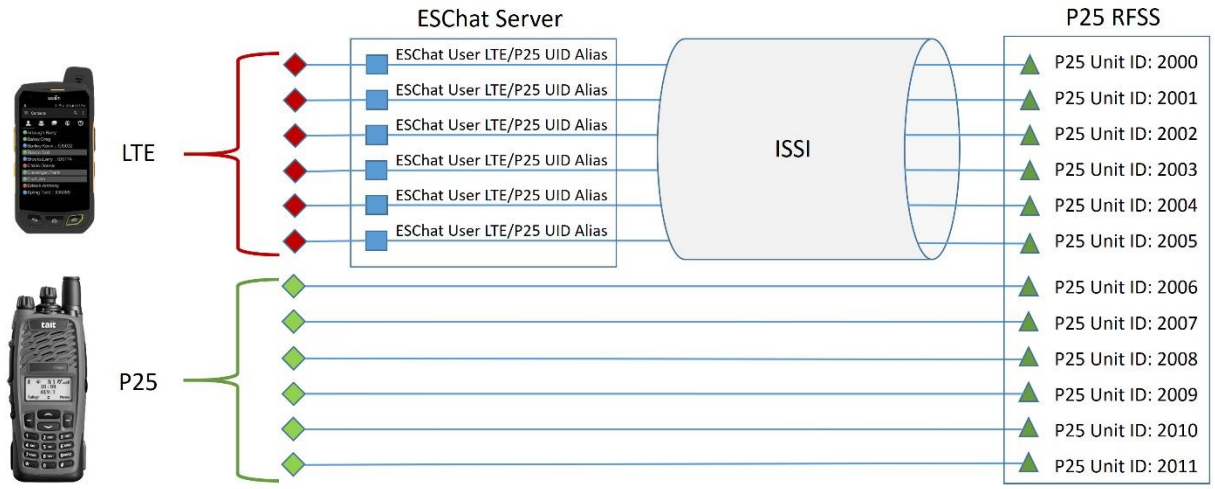
P25 networks include an interface called Inter Sub-System Interface (ISSI) that was developed to allow P25 users from one network to roam onto other networks. The ISSI interface is also ideal for use in connecting LTE-based PTT systems to P25 networks. This interface is a digital connection that does not require the use of donor radios. The ISSI interface supports:

- System-Wide Device IDs
- Private Calling
- Group Calling
- Emergency Group Calling

The initial setup of an ISSI-based connection is more involved than RoIP but the level of integration and the features gained are well worth the effort. The two diagrams below depict the relationship mapping between ESChat and P25 networks.

As implemented in the ESChat system, each user is assigned a P25 Device ID by the P25 home network. The ESChat system aliases LTE users to the P25 Device IDs over the ISSI connection. From the P25 system's perspective ESChat users are simply P25 radios and are treated as such.

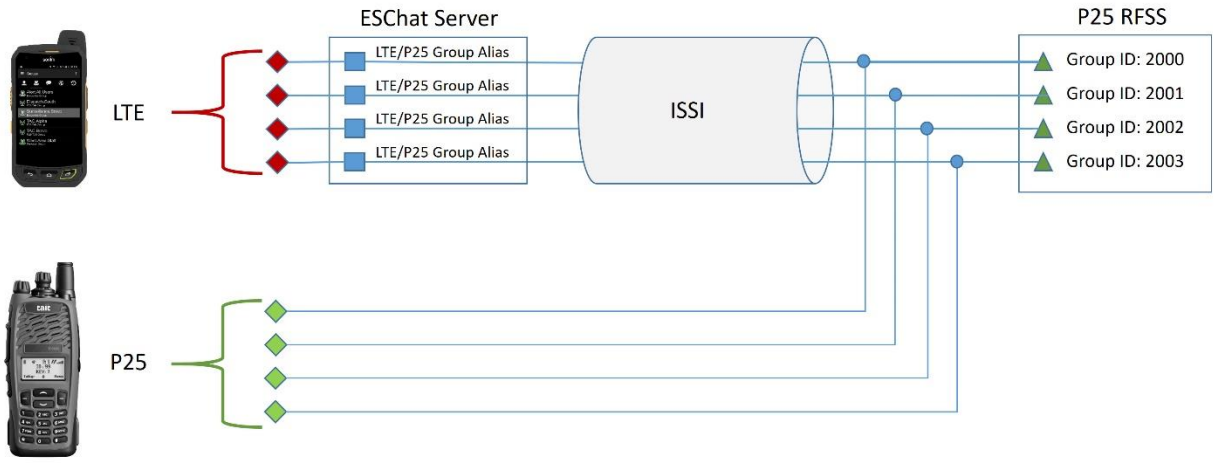
Device ID Aliasing between the P25 RFSS and the ESChat Server



Group (Channel) assignments are made in a similar fashion, where P25 Group IDs are aliased to LTE Groups in the ESChat system. LTE users of these shared Talk Groups are seen by the P25 network simply as P25 radios and are indistinguishable from other P25 users. The diagram below depicts how P25 Talk Groups are aliased to the ESChat LTE system.

Group (Channel) ID Aliasing between the P25 RFSS and the ESChat Server

(used for one-to-many form of PTT)

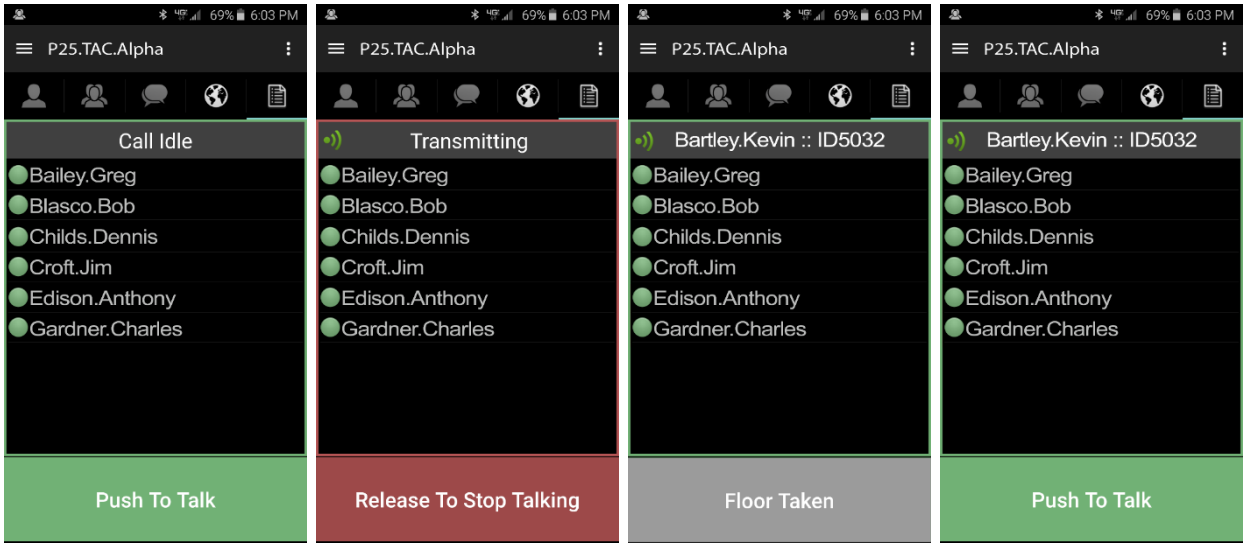


Impact on the User Interface

One benefit that results from using ISSI to integrate the LMR and LTE networks is the preservation of P25 system's rules for Priority and Preemption. Therefore, LTE users that are part of an ISSI-connected P25 Talk Group are bound by the same Priority and Preemption rules as all P25 radio users.

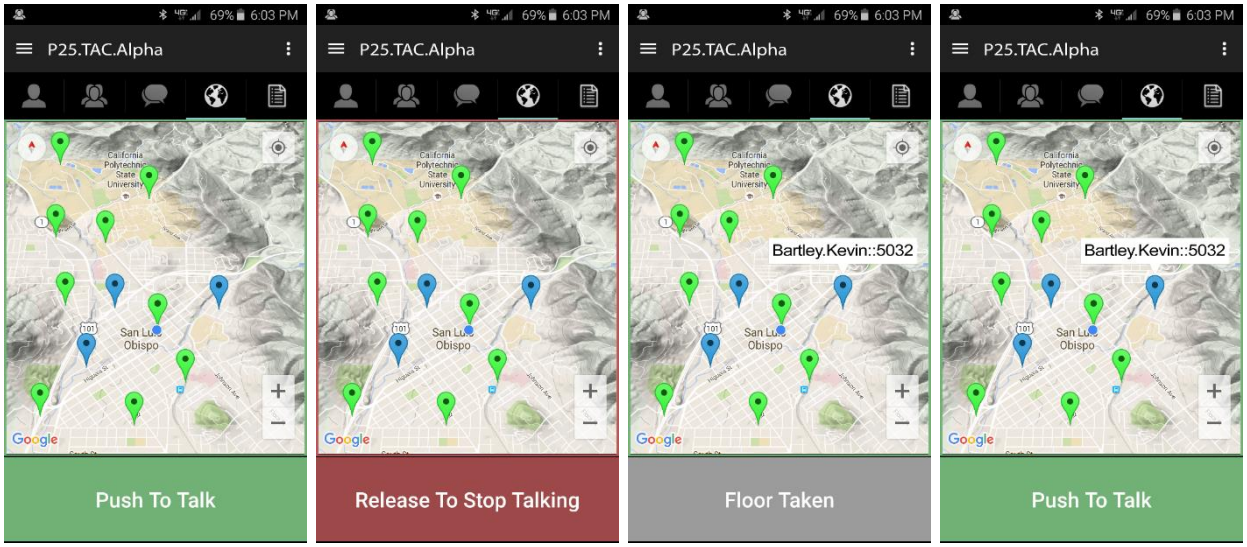
Adding the benefits typically associated with broadband devices to this architecture allows it to present users with information not available on traditional narrowband radios including text, video, and high-speed data services. Below is a depiction of four 'In-Call List View' screen captures during a P25 Group Call as viewed on a broadband smartphone device. The first two images show 'Call Idle' and 'Talking' states. Images three and four both show the 'Receiving' state and the Push to Talk Button provides a visual indication as to whether the user has sufficient privileges to 'take the floor' from the user currently talking.

ESChat In-Call Screen Captures – List View



Expanding on the features available over the ISSI interface, ESChat is able to overlay GPS-enabled P25 radio users onto its real-time location tracking and mapping architecture. The screen captures below show the same four In-Call states as above, here displaying the 'In-Call Map View'. The map pins shown in Blue are GPS-enabled P25 radio users, while the Green pins are the ESChat LTE users.

ESChat In-Call Screen Captures – Map View



DMR via AIS

The DMR standard offers a digital radio standard with a similar feature set to P25 but since DMR is not as encumbered with proprietary licenses and fees these networks come at a price point much lower than P25. One royalty bearing component that the two systems rely on is a voice encoder (vocoder) from Digital Voice Systems, Inc. (DSVI) refered to as Advanced Multiband Excitation (AMBE).

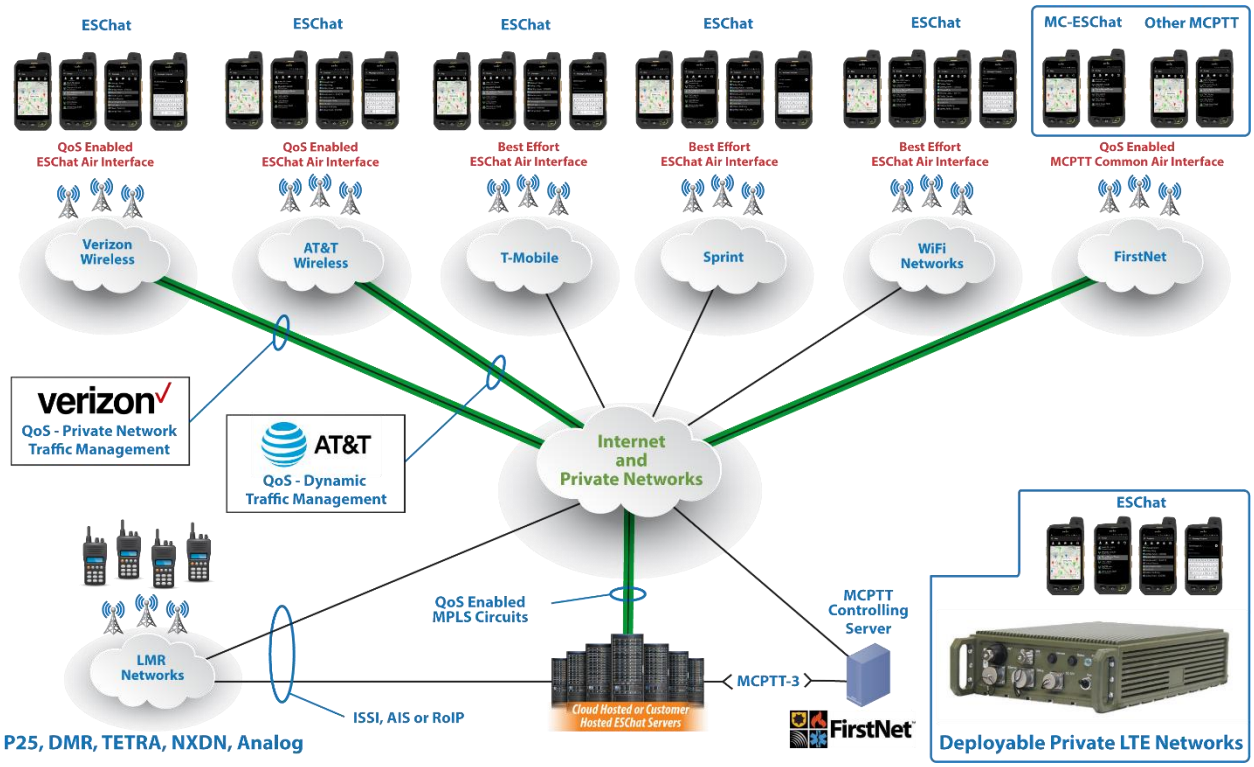
DMR offers conventional and trunked solutions that support private calls, group calls, and emergency calls. DMR systems are mostly used by commercial businesses in the transportation, utilities, and hospitality market sectors rather than within the public safety community.

Where DMR differs from P25 architecturally is that there is no need to connect multiple DMR radio systems together as you would in a public safety mutual aid scenario over P25. This is the main purpose of the P25 Inter Sub System Interface (ISSI). DMR did create an interface called the Application Interface Specification (AIS) that was intended for integrating console systems. The AIS interface is similar to that of ISSI and ESChat has implemented a DMR interface based on the AIS protocol.

All features included in the P25 via ISSI interface are also included in the DMR via AIS interface. User interface, priority, preemption, and all system features and call modes are supported including:

- System-Wide Device IDs
- Private Calling
- Group Calling
- Emergency Group Calling

Deployable and Private Networks

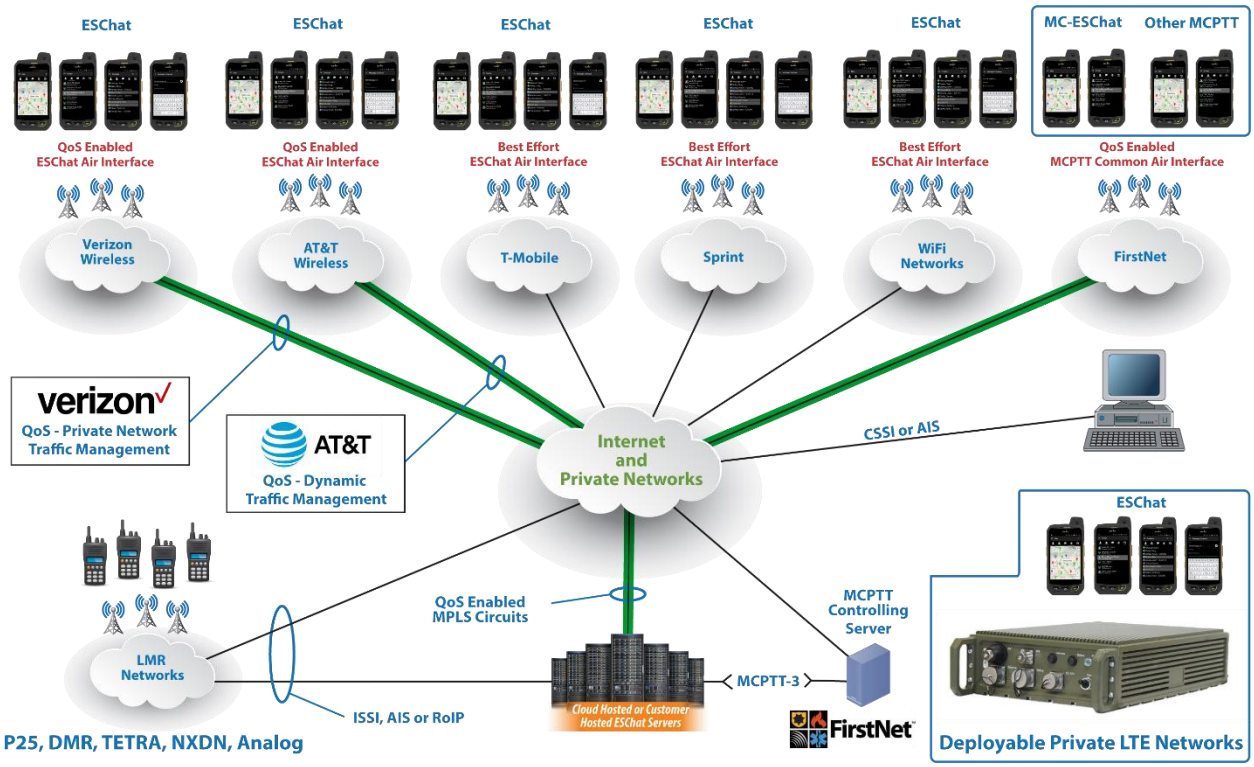


It is sometimes the case that the mission calls for a field-deployable or standalone push-to-talk system and wireless data network. These instances are common in the mining and utility industries where the remote locations are not serviced by traditional wireless carriers. In public safety, deployable networks can be ideally suited for use in Search and Rescue (SAR) and remote fire-fighting activities.

It is likely that Deployable Band 14 LTE systems will be required to meet the coverage requirements of FirstNet deployments. Deployable Band 14 LTE systems must be self-contained as they will not necessarily have access to a centrally located core network and an MCPTT server.

Other applications for private PTT networks are for military covert operations that can be rapidly deployed anywhere throughout the world. These systems are sometimes required to be ‘air-gapped’ and completely off-network, eliminating the option for backhauling to a central PTT server location.

Console Integration



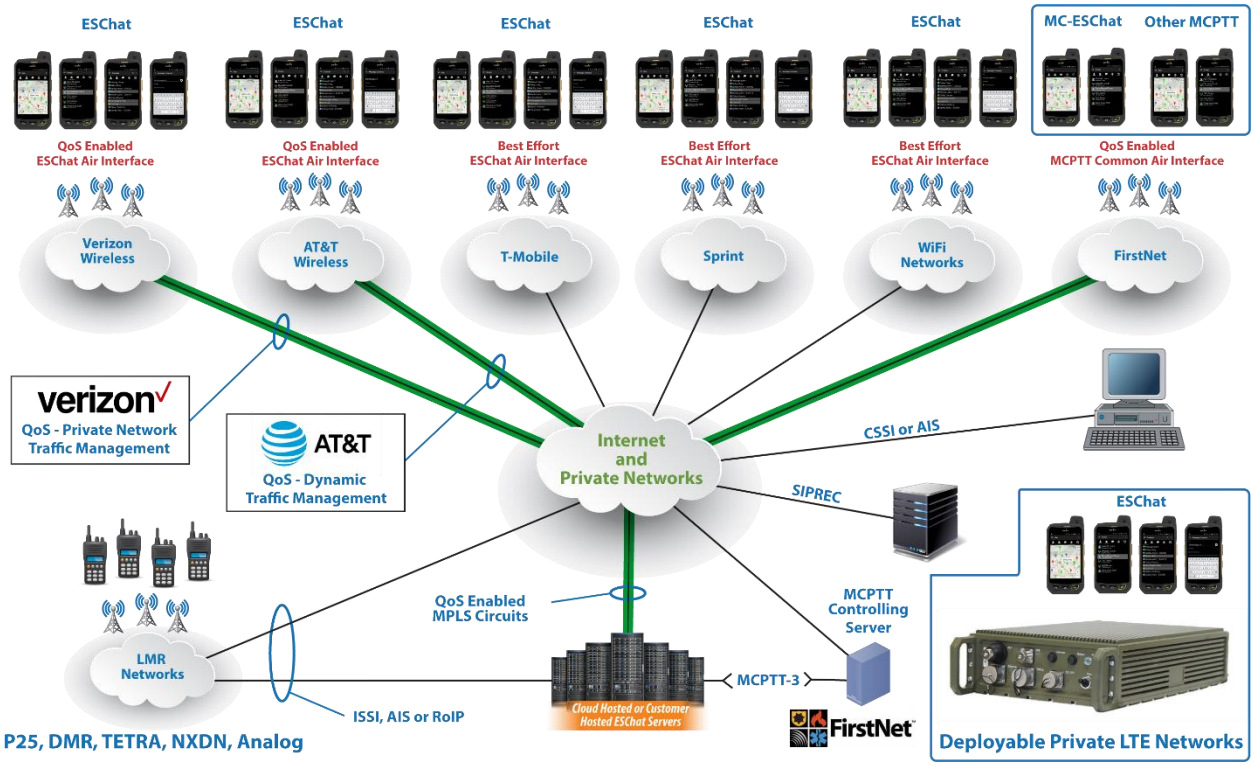
Console Integration

Traditional console solutions for dispatch of LMR users are common in commercial, industrial, and public safety networks. It is therefore only natural to expect that these consoles will seamlessly integrate with LTE-based PTT solutions. This is an example of how next-generation systems such as ESChat can benefit from the standards created for the earlier generation of LMR products.

ESChat users on standards-based console systems can directly connect to the ESChat network using the P25 Console Sub System Interface (CSSI) or the DMR Application Interface Specification (AIS). This interface provides for a seamless experience by dispatch professionals. The objective that was met by ESChat is to not require dispatch personnel to do anything differently than they have been trained to do to communicate to LMR users in the field.

There are times where legacy console systems are required for use with newly installed LTE PTT systems. ESChat also supports standard 4-wire interfaces to these legacy console systems. This is an inexpensive method to upgrade communications without having to rewrite processes or retrain dispatch personnel. Dispatchers continue to use their consoles as they previously did with their LMR-based radios. The result is that in mixed LMR/LTE systems, dispatchers will not be required to change their operational process or protocol.

Mission Critical Call Recording



It is often the case with large commercial and public safety agencies that all calls, standard duplex phone calls and PTT calls, need to be logged and recorded. The general public is most often exposed to these recordings during playback of 911 calls. There are a number of business and Mission Critical Call Recording systems available in the marketplace. These systems support recording and playback, both by date/time and by incident. Call recording systems can be hosted by the customer on its own premises or they can be operated as a cloud-based service. In the public safety environment, there are rules surrounding how these recordings are archived and how long they are retained.

There are a number of different interface options for connecting to the recording systems. Most common is a span-port connection where the recorder listens to an IP address/port pair and records Real-time Transport Protocol (RTP) voice traffic. This approach is most common where PTT users in the field can only talk to a dispatch center and are restricted from talking with each other (mobile-to-mobile). Since the recording system only needs to monitor traffic on the dispatch IP address/port pairs, this is easily manageable with an onsite call recording system.

Where it is required that all PTT calls be recorded, including mobile-to-mobile, SIPREC is the recording protocol of choice. SIPREC is an IETF standard (RFC 6341) that allows recording of all voice traffic on the network. SIPREC also supports enhancements for metadata so where available, data such as GPS coordinates can be included in the call burst metadata tags.

ESChat has an advanced SIPREC interface that enables SIPREC recording traffic to be stored and forwarded in the event the recording system has reached its capacity during an incident. While the voice traffic does not arrive at the recorder in real-time, the recorded streams are still identified with the metadata tags created by ESChat. This feature prevents loss of voice data and also enables customers to record more simultaneous calls when they exceed the number of channels on the recording system.

Conclusion

There are a multitude of Push-to-Talk over Cellular vendors, at last count my spreadsheet detailed the attributes of more than thirty, but in reality, there are only a few that serve the business and public safety markets. There are a number of free Over the Top PTT Applications that have enjoyed moderate success, but these companies do not understand push-to-talk requirements for today's markets nor what they will be going forward. PTToC brings more than voice PTToC services, including the ability to push photos and many other forms of data using emerging PTToC technologies. Voice is only the starting point for where this one-to-one and one-to-many near-instantaneous technology will take us.

Those making a decision about augmenting or replacing their Land Mobile Radio PTT system with PTToC need to keep in mind the differences between network-bound and Over the Top PTT systems. Both work well and both are providing PTT services to millions of users. However, those who choose network-bound systems including the new MCPTT standard passed by the 3GPP are limiting their ability to make changes in their network provider. Further, if the fleet that is making use of PTToC is operating in multiple locations within the United States the chances of the same network providing the best coverage in all of these locations is questionable. Many organizations make use of multiple network providers depending on where they are located and some PTToC customers that are concerned about redundancy and robustness make use of at least two different networks. The only product that can provide this type of robustness is OTT PTT systems and ESChat is the clear leader in the field.

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