

Push-To-Talk over Cellular:

Integrated LTE and LMR Communication

Success in the Mainstream

Prepared by:

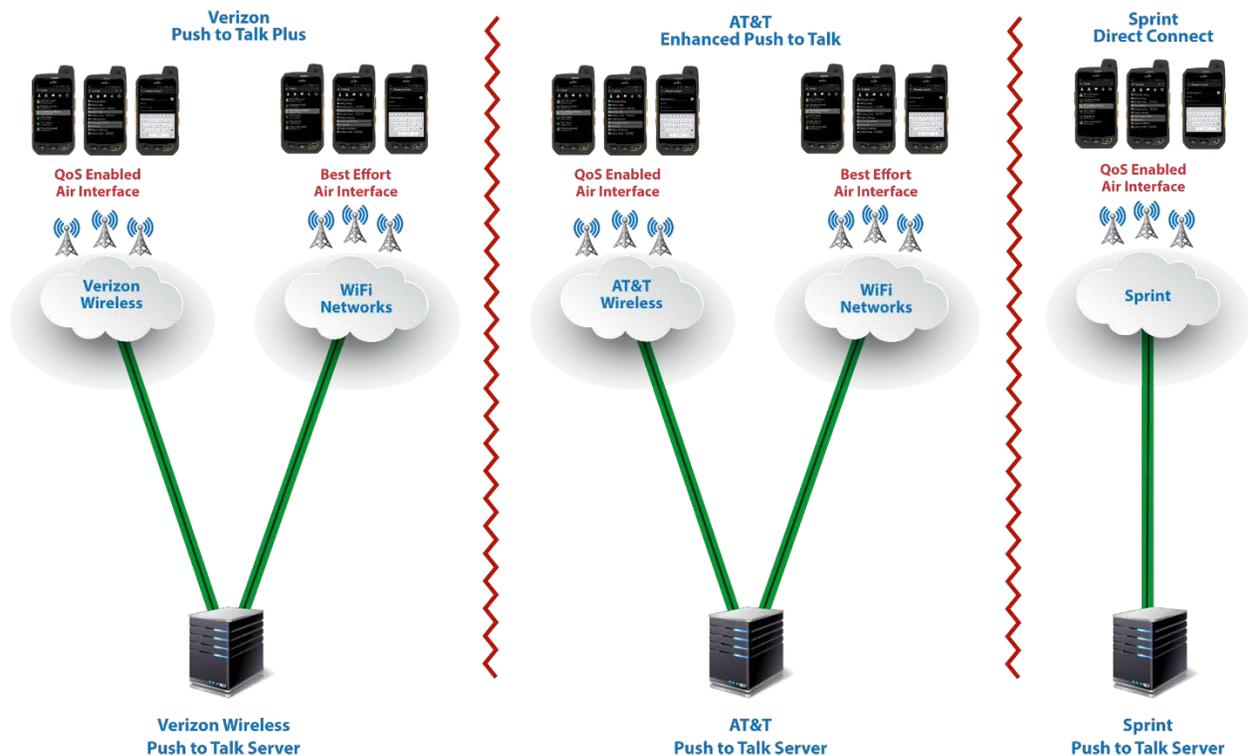
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Executive Summary

Push-To-Talk voice communications over cellular has now come of age. It is being used by both enterprise business and public safety customers across the United States. Sometimes Push-To-Talk over Cellular (PTToC) is integrated with existing Land Mobile Radio (LMR) systems and in other cases it is set up as an independent method of communications between only cellular devices. Either way it has proven to be a reliable, inexpensive way to instantly communicate one-to-one and one-to-many with the simple push of a button.

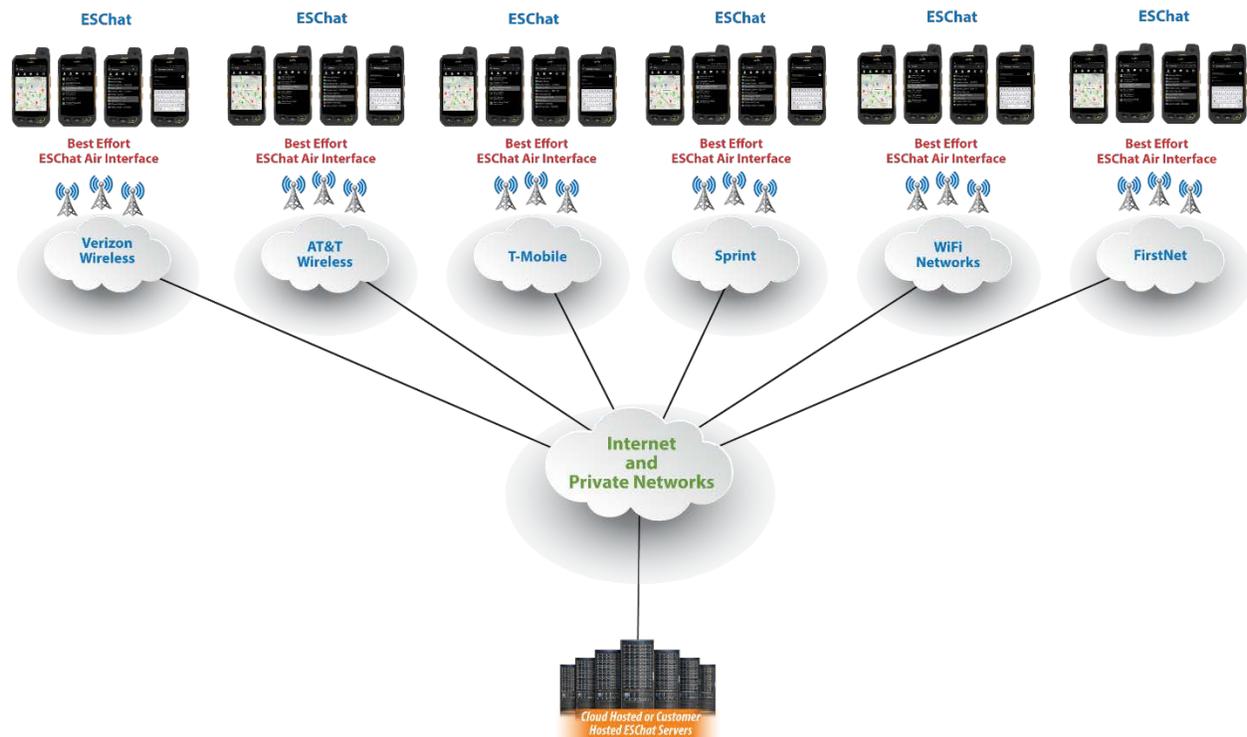
Sprint's 2004 acquisition of Nextel, the dominant [iDEN-based] PTToC network of the day, created the largest cellular network at that time. Sprint began a search for PTToC technology to incorporate into its soon-to-be-deployed 3G network. The vision was to migrate Nextel subscribers off the iDEN network onto a new 3G network with PTToC technology that would perform as well as iDEN. Sprint selected Qualcomm's Qchat platform as its PTToC technology. At the same time, believing its 3G was sufficient to provide PTToC service, Verizon Wireless and AT&T also entered the market with **Carrier Integrated** PTToC.

Carrier Integrated PTToC



In June 2013, the FCC lease used for iDEN was set to expire. Sprint's iDEN users who were not happy with the Sprint Qchat service sought service options from the other sources. In addition to the **Carrier Integrated** PTTToC offerings from Sprint, AT&T and Verizon, a number of new PTTToC suppliers had emerged and were offering **Over the Top** Push-To-Talk over Cellular or OTT-PTTToC. The landscape today is that three of the major wireless network operators offer their flavor of **Carrier Integrated** PTTToC, which is only available to their own customers, and the **OTT-PTTToC** companies that offer services on and across multiple networks. The dominant OTT-PTTToC supplier is **Enterprise Secure Chat (ESChat)**, that launched its service in 2008 and serves the U.S. Military, federal, state, and local public safety agencies, utilities, and the nation's leading transportation and construction companies. The diagram below depicts ESChat's original **Basic Over the Top** PTT service architecture.

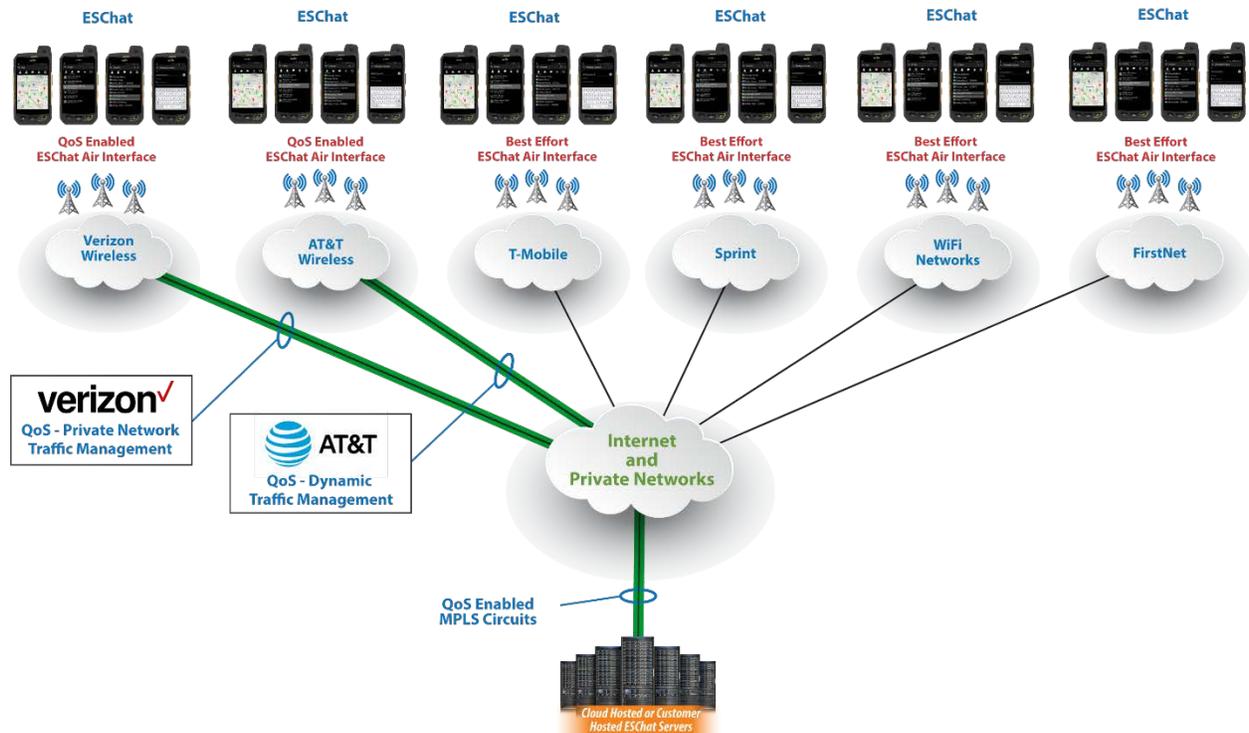
Basic Over the Top (OTT-PTTToC)



AT&T, Sprint, and Verizon all point to the fact that their PTTToC is embedded into their network as a core offering and therefore, their offering is superior to the **Over the Top** architecture. The reality of the situation is that **Carrier Integrated** systems are incompatible with each other and, therefore, customers have to not only choose to implement PTTToC, they also have to choose one network for all their devices. OTT-PTTToC is different in that it permits users on different networks to use PTTToC services across and between commercial networks including those that do not offer their own PTTToC service. Additionally, wireless carriers are now offering **Enhanced Quality of Service (QoS)** to their business and public safety customers. These carrier QoS offerings include the wireline Multi-Protocol Label Switch (MPLS)

connections to the PTT servers and also LTE network priority. ESChat has integrated its system with enhanced QoS and refers to it as **Advanced Over the Top**. In this way ESChat can now claim the same advantages as the **Carrier Integrated** options but without any restrictions in cross-carrier communications.

Advanced Over the Top (OTT-PTToC)



Recently, at the behest of Public Safety Communications Research (PSCR), a division of the National Institute of Technology (NIST), the standards body for fourth-generation broadband wireless (3GPP) passed a standard for Push-To-Talk over LTE networks. This new standard is, unfortunately, called **Mission Critical Push-To-Talk over LTE (MCPTT)**. I say unfortunately because the name implies that making use of this standard on an LTE network will provide mission-critical voice services. However, true mission-critical communication networks require much more than the elements addressed by the 3GPP MCPTT specification. Devices and accessories for example, are key components not mentioned in the specification. Adding to the complexity is that the world is transitioning from narrowband LMR to broadband LTE technology. New capabilities will include video, location tracking, mapping and other services. These services are most often associated with a 'smartphone' type of device. However, the PTT use case for traditional first responders requires heads-up operation while smartphones beg for users to look at screens. New procedures and training will be required to take full advantage of new system features. Therefore, the MCPTT standard is only part of what might eventually become a true mission-critical product offering. All this will require not only implementation of the MCPTT standard but major

upgrades to any LTE network, devices, accessories, and other components required to provide customers with true Mission Critical PTT service.

At this point in time there are a host of Push-To-Talk over Cellular vendors all pursuing the enterprise business, first responders and second responders. This second group includes the public safety community, which is making use of PTT over Cellular not as a replacement for its existing and Mission Critical PTT over Land Mobile Radio, but as an adjunct to it. Second responders include organizations such as tow trucks, power companies, and other utilities that oftentimes become part of an incident call-out. The matrix below highlights PTT over Cellular features supported across four types of PTT over Cellular networks. The first are Basic Over the Top applications, many of which are free. Next are OTT vendors (much fewer in number) that have integrated with Carrier Enhanced QoS. Third are wireless carriers that have integrated PTT over Cellular technology into their network. The final column compares the other three to what is contained in the 3GPP Mission Critical Push-To-Talk standard that has been published but has yet to be implemented.

Feature Matrix for PTT over Cellular 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

Of note, to me at least, is that the 3GPP MCPTT standard is lacking in features already being offered by others, and it appears as though there is no requirement for the standard to be cross-network capable. Also, beyond the comparisons made in this chart, there are a number of apparent discrepancies between P25 Push-To-Talk features and functions that should have been the model for the MCPTT standard. Many P25 features and functions appear to be missing altogether in the MCPTT specification as presently written.

The main value for PTT over Cellular when employed by the public safety community is not that it will be used as a standalone technology, replacing existing Land Mobile Radio PTT, but that it will be an adjunct to LMR PTT and that the two can be easily cross connected. It appears from what I have seen that when P25 Push-To-Talk is finally cross connected with MCPTT systems some of the functions and features available on a P25 network will not be available on the LTE network. If this turns out to be the case, it will mean that those who employ MCPTT LTE will have to understand the differences between its functionality and that of P25 PTT. Public safety has enough to be concerned about when onsite at an incident without having to stop and think about differences in feature sets between LMR and LTE PTT systems.

Interoperability

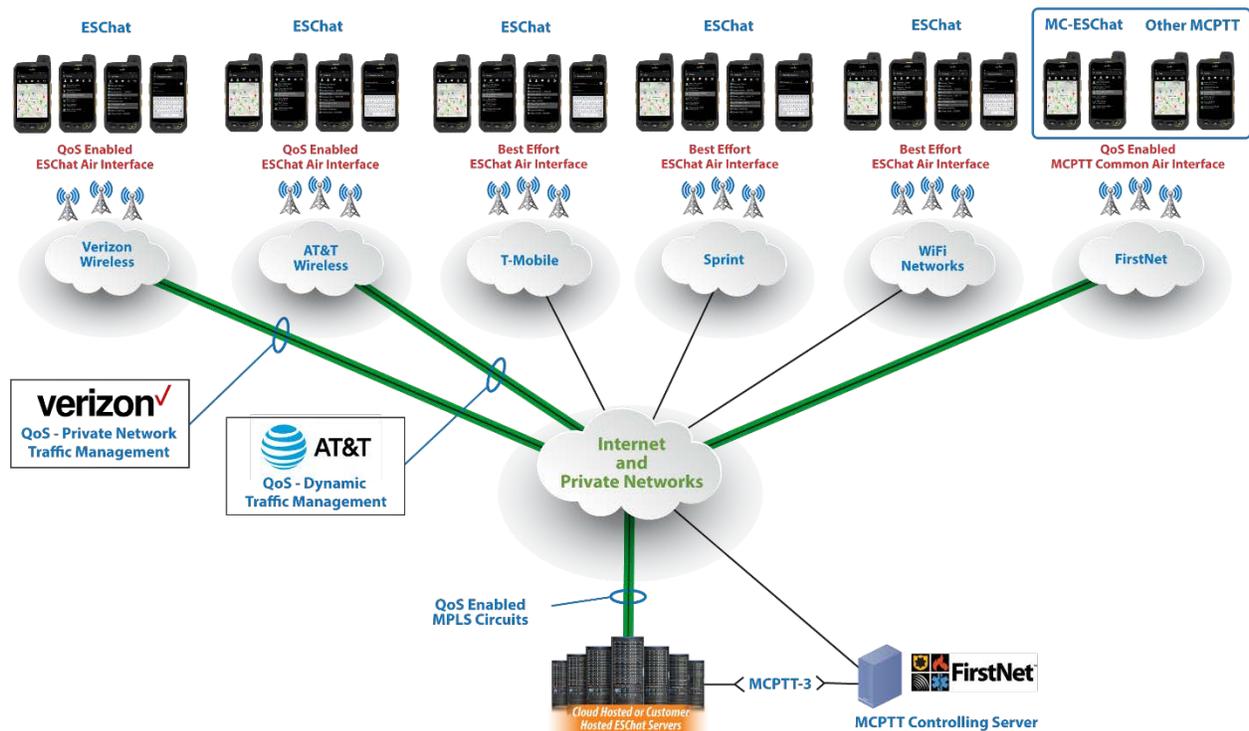
The next point to be made when looking at the various types of PTT over Cellular are concerns surrounding interoperability. Today, for example, AT&T and Verizon are using the same vendor to provide their Carrier Integrated PTT solutions yet the two companies have no interest in offering cross-network PTT services. On the other hand, Over the Top applications work across most if not all networks that are deployed. I happen to believe that real growth in the PTT over Cellular market will not happen unless it includes the ability to use PTT services across different networks. If you look at past cellular history, you will see that text messaging, multimedia messaging, and other technologies never really reached critical mass until they were implemented across different networks. Requiring anyone who uses a feature of the network to have to communicate with only those on the same network will not promote the growth of that feature or function. In this regard, Over the Top solutions have a distinct market advantage.

As mentioned above, the only vendors that offer network-agnostic PTT over Cellular today are those that offer Over the Top service. They can operate across multiple wireless networks providing the best solution for businesses and agencies that operate across multiple wireless networks due to coverage or other preferences. Even AT&T and Verizon, which are using the same PTT over Cellular vendor for their on-network systems, have not indicated that they have any plans to provide PTT over Cellular interoperability across their two networks.

When FirstNet comes online it will make use of a single MCPTT Application Server (the Controlling Server) as identified in the 3GPP specification. The specification defines an interface (MCPTT-3) that supports connection to a third-party PTT over Cellular Server (the Participating Server). ESChat has taken the approach to update its products to be dual-mode. They can operate using its standard Advanced Over

the Top mode, but can also operate seamlessly in MCPTT mode on FirstNet. This is possible because MCPTT defines a common air interface that will allow multiple MCPTT-compliant client devices to work on the network. ESChat's belief is that first responders will want to select their wireless carrier and will demand seamless interoperability as it today with P25. This is consistent with the main purpose of FirstNet, which is to provide interoperable communications for the public safety community from coast to coast. Further, as the FirstNet system is being built and put into operation, it will be common for public safety to roam freely from FirstNet to a commercial network or two and then back again. If PTToc products are not compatible with the standard on both the FirstNet and the commercial network, the entire premise of interoperable communications, at least for PTT, will not be easily implemented.

ESChat Advanced Over the Top PTT Integrated with Mission Critical Push to Talk (MCPTT)



Interconnection

One of the reasons PTToc has grown over the the past few years is the fact that it can be interconnected to existing Land Mobile Radio PTT systems. This is vitally important for a number of reasons. For

enterprise customers that have been making use of an LMR system of their own or shared with other enterprise users, being able to connect their existing LMR network directly to the PTTToC units on one or more commercial network provides a huge amount of flexibility. Here are some of the most common reasons for transitioning to PTTToC:

- 1) Executives can carry a single cellular device and still be able to communicate with their employees who are using the land mobile radio network.
- 2) Field workers, who today carry both an LMR radio and a smartphone can give up the LMR device in favor of the smartphone.
- 3) The enterprise can easily transition from its LMR system to a combined LMR/PTTToC system and then to a PTTToC-only system without concern for losing communications during a transition.
- 4) The PTTToC system can add capabilities over and above what are generally available on the LMR systems. This includes GPS tracking of users, the ability to assign the nearest user to a new call that is received, to provide positive time stamps for each operation carried out in the field, and many other things.

The integration between PTTToC and LMR networks can be accomplished in a number of ways. The simplest is to install a Radio over IP (RoIP) bridge between the networks. RoIP bridges can be manually set up by a dispatcher when needed, or they can be semi-automatic or fully-automatic bridges that are available and can be turned on or off by those in the field as needed. Some of the more advanced PTTToC systems offer features and functions not normally available on older analog LMR PTT systems. These include private (one-to-one) calls between a radio and smartphone, priority, preemption, system-wide device IDs, data encryption, messaging, and location services.

Integrated LTE and LMR PTT Communications



If the existing LMR network is based on the newer P25 or Digital Mobile Radio (DMR) standards in use by many, especially in the public safety and utility markets, the choices for interconnection are not only better but more robust and they provide much if not all the same functionality between LMR devices and PTTToC devices. The best way of interconnecting a P25 and PTTToC is referred to as the Inter RF Subsystems Interface (ISSI). ISSI was originally designed to enable different P25 vendors to interconnect different types of networks. Today it provides the most robust interconnection between P25 and PTTToC

systems available. For DMR networks, there is the Application Interface Specification (AIS), a specification similar to ISSI.

Connecting PTTtoC to P25 via ISSI, or PTTtoC to DMR via AIS, provides the most feature rich interoperability available today. However, it should be noted that with some PTTtoC products there remain gaps in the system features available in PTTtoC and P25. An example of one missing and important function is the remote kill/stun command. This command is vitally important if a device is lost or stolen because it will remove the device from the network and render it useless to anyone who has it in their possession. Though this feature is supported in some PTTtoC products, the command is not supported over ISSI or AIS. Therefore, dispatchers who have the ability to issue the stun command via their dispatch console now require a second user interface, which complicates their job. If anything, this type of command is even more necessary in the LTE world since many more cellular devices are lost or stolen than LMR radios.

Integrated LTE and LMR PTT Communications



Still, using the ISSI and AIS methods of interconnection are the best for cross-connecting two or more networks. It is our belief that PTTtoC for public safety making use of the FirstNet LTE network will be used primarily as a way to provide interoperable voice communications during incidents where different agencies and departments are involved. The ability to cross-connect LMR and PTTtoC LTE systems will help solve one of the greatest problems faced by the public safety community today. Public safety operates on multiple different portions of the radio spectrum and it is not unusual for one public safety organization to be using LMR radios in the VHF portion of the spectrum while the next town or county is using LMR radios on the UHF band. In this case, the FirstNet LTE system, cross connected to one or both of these systems, can provide a common PTT voice communications path so all agencies involved in the incident can coordinate their tasks and responsibilities.

The interconnection discussion leads to the next set of issues that need to be understood, not only by those who use PTT systems, but also by those who fund the LMR PTT systems. The big question in many minds is if or when will PTT simply replace LMR PTT systems. I believe there are two different and distinct answers to this question. The first answer is for business and industrial LMR users and the second is for the public safety community including all users who are dealing with life or property issues. The answer in many cases also depends on whether a person or organization has had true hands-on experience with LMR PTT or is simply in a lab or executive environment where decisions are sometimes not based on realities faced by those in the field.

Dispatch Console, LMR and LTE Systems Fully Integrated and Compliant to P25 and DMR Standards



In order to better understand these two groups and the opportunities PTT affords to each, let's take a look at the similarities and differences in their requirements. The first group is made up of industrial and business LMR users. For the most part, their usage is self-contained within a single company or entity and they have no need or desire to be able to use PTT with others outside that sphere. On the other hand, the second group, public safety, not only needs to make use of PTT within their own organization but many times must also include other agencies and/or jurisdictions responding to the same incident.

Next there is the difference in how PTT is funded. There are two types of funding and they have different implications. The first is self-funding provided by the business and industrial LMR community. The second is the funding controlled by elected officials at various levels of government. A business sees PTT as a time saving, cost saving, better customer service type of investment. However, public safety sees PTT as not only all of the above, but also as instant communications to summon help and save the lives of the citizens they serve and, potentially, their lives as well. The second responder community, the utility companies, tow trucks, and others, can fall into this category as well since they may, in fact, be

responding to a life or death or property damage-related situation. So the method in which PTT is used is one of the determining factors as to the type of PTT that is needed, and the funding differences can be categorized as commercial business critical vs. public and life safety—a nice business tool or a must have.

The Business Case

Business and industrial LMR PTT users are finding that PTTtoC services being offered today are robust and cost effective, and they enable all who need PTT to use the same device they typically use for texting, Internet access, and routine telephone voice conversations. These businesses are paying for radio equipment, radio site rental, perhaps shared radio use fees, maintenance charges to keep the equipment operational and, of course, the LMR PTT devices mounted in their vehicles or carried by their employees.

When trying PTTtoC, they quickly discover how well it works and that they can also interconnect PTTtoC back to their existing LMR system. From that point on, they have the flexibility to keep both systems in operation or to phase out their LMR system in favor of all-PTTtoC devices. Because of this, the number of PTT over LMR users in the business and industrial markets is shrinking year over year.

On the other hand, LMR systems being employed by the Public Safety community are growing in numbers and being updated and expanded into regional systems. The primary reason for this is that LMR PTT for public safety is close to being fully mission-critical and most LMR systems have several levels of fallback built into them so that a failure at the radio site is not necessarily a catastrophic incident. The final form of graceful degradation for these networks is the ability for these units to talk one-to-one and one-to-many without the need for a network and to gain coverage into buildings that many networks cannot penetrate today.

Some are predicting that once FirstNet is built and operational, all PTT services can and will be moved over to the FirstNet LTE network and the LMR systems can be decommissioned. These predictions are not being made by those whose lives depend on LMR PTT today, but by those ensconced in a lab, working as executives, or elected officials, none of whom have ever ridden in a police car, fire engine, or EMS squad vehicle on a Friday night. Their experience, for the most part, is limited to using smartphones and it is difficult to make them understand the differences between a dedicated LMR device and a smartphone.

What FirstNet and other LTE networks can provide for the public safety community for the next few years is a way to deliver the interoperability discussed above. Will FirstNet ever be ready to support all of the voice needs of the public safety community? The only people who can answer that are the public safety users themselves. Perhaps, over time, they will use their LMR PTT radios less and their PTTtoC devices more. Perhaps, over time, FirstNet and commercial broadband networks will become more mission-critical. When PTTtoC is fully trusted by the public safety community and chief officers all over the United States believe they can trust the lives of those in the field to PTTtoC, then and only then,

PTToC might start to replace public safety LMR systems. Until then, PTToC is a great adjunct and another tool in the communications toolbox of the public safety community.

Conclusions

In 2005, it was estimated that Nextel had more than 20 million subscribers. Today's market is estimated to be of similar size, though users are spread across the Carrier Integrated and Over the Top offerings. With Carrier Enhanced QoS available and integrated vertical services such as location, messaging, and LMR interoperability, Over the Top vendors are best positioned to capture new PTT subscribers. It should be noted that in the course of my research, I found ESChat to be the only OTT-PTToC company that has integrated with the Carrier Enhanced QoS networks.



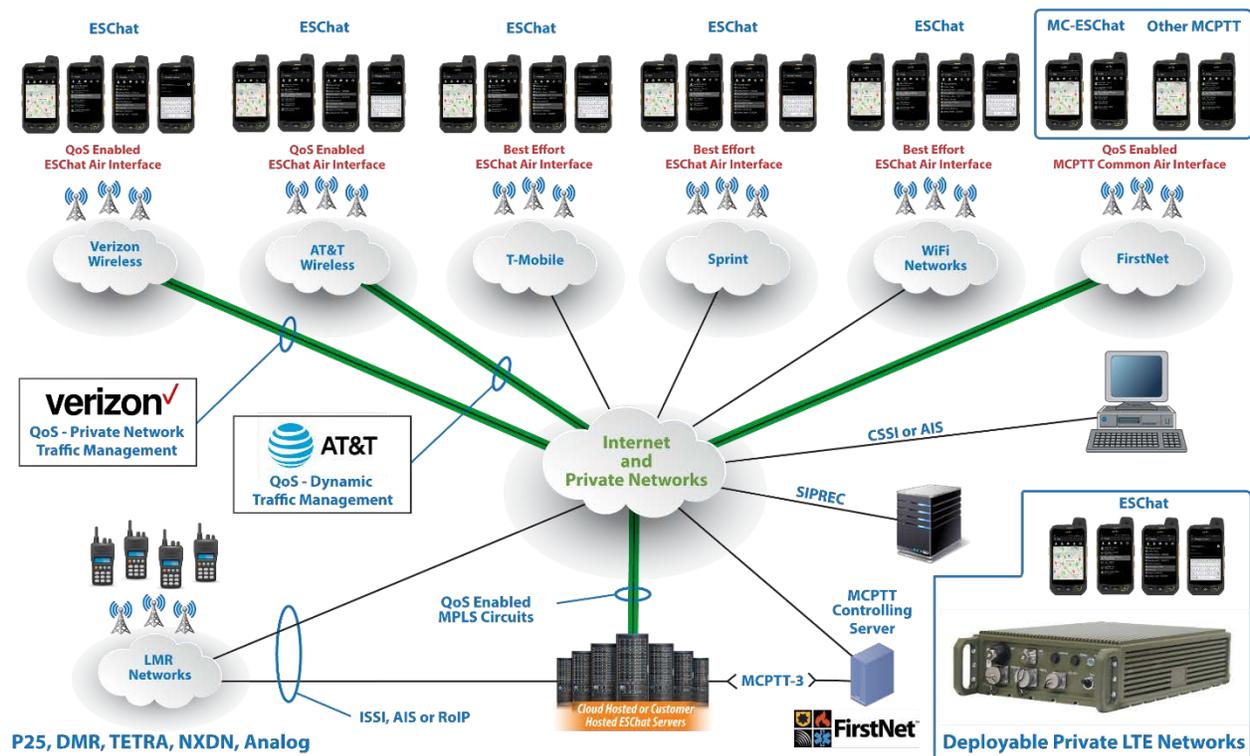
All said, PTToC is a tool used by the professional workforce. It is not a social network and as such, remains somewhat of a niche market. There does not appear to be any pent-up demand for consumers who make use of social media to be able to quickly and easily chat among themselves using near-instantaneous voice. Thus PTT will remain the purview of businesses and first and second responders around the United States and elsewhere. The choices for the types of PTToC will diminish as the winners add users and those offering free or non-competitive products fade away.

Listing all the elements required in a complete PTT network architecture, ESChat's Advanced Over the Top model remains the only one that addresses all of the necessary components.

- Instant Secure Push-To-Talk Voice and Group Text Communications
- Live and Historical (Bread Crumb) Tracking and Mapping

- Carrier Agnostic
- Cross-Carrier Operation
- Wireless Carrier Enhanced Quality of Service (QoS)
- P25 to LTE PTT Voice and Location Integration via ISSI
- DMR to LTE PTT Voice and Location Integration via AIS
- Mission-Critical Recording via SIPREC
- Dispatch Console Integration via Console Sub-System Interface (CSSI)
- Cloud and Customer Hosted Server Options
- Deployable and Off-Network Systems
- Compatible with Future 3GPP Mission Critical Push-To-Talk (MCPTT) Networks

ESChat's Advanced Over the Top Network



When I last wrote on this subject, I contacted four of ESChat's customers; **AAA of Missouri (AAA)**, **American Medical Response (AMR)**, the **Seattle Police Department**, and the **San Bernardino Sheriff's Department**. During our follow-up, I contacted these customers again and confirmed that not only were they still ESChat customers, but that they had since grown their ESChat user base.

The number of ESChat customers continues to grow and, most importantly, its existing customers keep adding more devices. If you are in the market for PTT to C you need to first determine exactly what your

needs are, then review the offerings available to you, and then test the two or three top contenders side by side to determine which choice offers you the best service, the best selection of features, and the best set of solutions for interconnecting your LMR system to your PTTToC system.

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