ANDREW**SEYBOLD**

Push-To-Talk over Cellular:
Integrated LTE and LMR communication ready for mainstream!

Prepared by:

Andrew M. Seybold
AndrewSeybold, Inc.

February 24, 2015

ANDREWSEYBOLD

Executive Summary

Today's wireless broadband and cellular users communicate in a variety of ways including text, email, and traditional dial-up two-way voice conversations. However, there is another very powerful form of voice communications now available on commercial wireless networks. This voice service provides one-to-one and one-to-many communications not only on the commercial network the user subscribes to but, depending on the vendor, across multiple commercial networks, and it can be cross-connected to other similar types of voice communication systems.

This is called "Push-To-Talk" or "PTT." When used over commercial wireless systems it might also be referred to as Push-to-Talk over Cellular or POC. PTT has been used by many organizations since the 1930s, and it is the typical type of communications used in military and aviation communication. PTT is efficient and very fast. There is no need to enter a series of numbers, wait for the call to connect, ring, and then be answered. Instead, call setup is streamlined and connections are nearly instantaneous. PTT is not limited to one-to-one communications the way traditional wireless voice calls are. Users can communicate to and among groups of users spread out inside a single building or across the globe.

After the advent of cellular service in 1991, PTT services were not offered by any of the commercial providers until Nextel was formed in 1996. Nextel was the only PTT provider on a commercial network and it made use of a proprietary PTT system. When Sprint took over Nextel, it, too, found a solution and added PTT to its offering, which was, again, proprietary. Today, AT&T, Sprint, and Verizon all offer their own versions of PTT and each of these is available only for use across their own networks.

With the advent of third-generation (3G) and then fourth-generation (4G or LTE) technology, it became possible to create a push-to-talk over cellular system that would run across multiple wide-area networks as well as on in building or Wi-Fi systems. This type of system is gaining acceptance because it is not limited to a single network operator or a small number of devices. One of the leading companies within this segment of the PTT market is SLA with its ESChat offering. SLA continues to add customers and customers that have been with SLA for a few years are signing new service agreements when their current contracts expire. The fact that existing users are returning as longer-term customers speaks well for both the company and the product.

Even though POC is available from many different vendors, each offering a different type of service, POC is still very much a niche market. The main reason for this is that today's POC customers are people who have previously used PTT on dedicated networks or the Nextel system. People who have grown up with only cellular or wireless devices and have never experienced PTT do not have any idea of how powerful a tool it can be. Even the wireless network operators that offer PTT services on their networks are not truly promoting it. If you walk into one of their company-owned stores and ask about PTT, the usual reaction is one of confusion since these salespeople are not trained or even exposed to their own company's PTT offering.

To be successful in the commercial push-to-talk market, certain high-performance elements must be present. The first is very fast setup time. When the first PTT user pushes the PTT button on the device or on the screen, he/she expects to be able to start talking immediately. However, there is always some lag time to set up the connection. This time must be minimized and must be less than a second. Next is the volley time where the first person lets go of the PTT switch and the second person responds. There can be no delays in volley time or the system will frustrate the user community. In the world of Public Safety mission-critical communications the standard test for PTT timing is to depress the PTT switch and say, "Don't Shoot," into the microphone. If those listening do not hear the first word the system is too slow!

There is another set of features and functions, many are must-haves and some are nice-to-haves. SLA's ESChat provides virtually all of these, enabling its users to interconnect with several types of existing Land Mobile Radio (LMR) PTT systems and dispatch consoles. ESChat provides PTT access to individuals and groups, and is capable of showing individual and group status. It supports preemption, and provides voice encryption and GPS location across both the cellular and LMR networks. There are many POC companies both on the network and on the PTT application side, but few that can compete with the features and functions of existing Land Mobile Radio PTT services. SLA's ESChat stands out as the most complete POC offering available today, and the company appears to be focused on maintaining this market position into the future.

PTT over cellular or POC enables people who had carried two devices—one cell or smartphone and one two-way radio or LMR handheld radio—to now carry one cell phone or smartphone and still be able to use PTT with anyone on their existing LMR PTT system. This not only cuts down on the cost per person, it makes people more efficient and they don't need to hear their LMR radio blaring while they are in meetings or having discussions. Further, LMR PTT service is limited to a specific area, perhaps in a city, but POC is available nationwide. Thus those who have switched to POC not only gain the advantage of a single device but also the advantage of being anywhere and being able to access their LMR network and/or communicate with others on the LMR network.

Today there are no nationwide or worldwide standards for POC. This has led to situations when PTT capabilities across agencies or between companies will not work. While there appears to be a standard for POC on the horizon, it will take a long time for it to be implemented. Further, it is only a standard for 4G or LTE and it is not backward compatible with 3G systems, which today, are still prevalent inside and outside the United States. There is a need, therefore, for companies offering POC to be able to provide interoperability between companies and users. SLA with ESChat addresses this requirement and solves this problem as well.

Push-to-talk over cellular should be used more widely than it is. There are many uses for instant one-to-one and one-to-many communications. However, the PTT solution is not widely advertised or discussed, therefore it remains a niche service. The demand for POC is growing but mostly among those who have experienced push-to-talk either in their dedicated LMR systems or on the Nextel wireless network.

Once wireless customers begin to understand the implications of fast one-to-one and one-to-many communications, the ability to see who is online and available for a call, and the other capabilities offered by POC, it does not take long for them to want to try it themselves. Once they have tried POC, they almost always purchase the service. And then wonder how they ever got along without it.

Andrew M. Seybold
CEO and Principal Consultant

ANDREW**SEYBOLD**

Push-To-Talk over Cellular:
Integrated LTE and LMR communication ready for mainstream!

Introduction

Since the 1930s, "Push-To-Talk" (PTT) has been used by the military, police, fire, EMS, and business and industrial two-way radio users for conducting voice conversations over a radio channel. Over time, push-to-talk systems evolved to provide more capabilities, but its fundamental purpose is for one person at a time to be able to speak to one or more listeners simultaneously, and near instantly. No dial tone, simply push the PTT button and talk.

This unique form of near-instantaneous communications is not possible with typical dial-up wireless services. The more important it is for people to communicate with each other in near-real time, the more important push-to-talk becomes. Today PTT is used by delivery services, hotels, utilities, within the services sector, at conventions, in warehouses, and anywhere dispatchers must keep track of mobile resources and direct their positioning. Moreover, PTT is the primary form of wireless voice communications used within the Public Safety community.

In traditional two-way radio systems (Land Mobile Radio (LMR)) the delay from the time the PTT button is pushed and the transmission begins is measured in milliseconds. When the user lets go of the PTT button another user can answer, again, within milliseconds. The timing of the "setup" and "volley" are critical. For example, push the PTT button and say, "Don't Shoot!" If listeners hear "Don't shoot," the system is functioning properly. If they miss the first word, the results are not as intended.

Early competitors to LMR did not understand how critical fast setup and volley times are. Nextel's PTT came close to LMR times and provided a near-instantaneous "beep" to indicate connection to the network, setup completion, and that a PTT conversation could begin. In its heyday, Nextel had more than 18 million customers.

Sprint purchased Nextel in 2005 and proceeded to deploy its own PTT service, moving customers off the Nextel channels in order to implement broadband services on them. Shortly after the merger, Verizon and AT&T ventured into the push-to-talk market but were not competitive.

With third-generation technology it became possible to provide adequate on-network PTT solutions and Sprint, Verizon, and AT&T found solutions acceptable to users with previous PTT experience. Unfortunately, each network decided on a different vendor and technology and there was no possibility of cross-network PTT service. SMS/texting did not become popular until it was available across multiple networks, the same was true for Multi-Media Services (MMS), and yet the networks are offering proprietary PTT communications. These three networks combined have fewer PTT customers than Nextel in its heyday, primarily because their PTT services are confined to their own networks.

The Next Generation

The rapid development of third and then fourth-generation (LTE) wireless technology along with the explosion in the numbers of smart devices and applications has offered an opportunity for some companies to see a broader market for PTT or what is being called PTT over Cellular (POC). These companies are providing POC as an application rather than yet another add-in to a commercial network that only works within that network. By building an application and the back-end infrastructure that goes with it, POC vendors can provide a solution that can be installed on virtually any device and will work across different commercial networks as well as Wi-Fi networks.

In fact, the POC application works over both Wi-Fi and commercial networks as more and more network operators offer voice and data access to their networks via Wi-Fi in order to off-load them. This is a real advantage because many locations have in-building Wi-Fi but lack network coverage indoors. Because the POC application can use either path to provide PTT, the system works across networks and over Wi-Fi for the best of all possible worlds and the broadest of coverages.

One of the prime target markets calls for integration of POC with existing land mobile radio PTT systems. With this integration, upper management and administrative personnel can carry a single smartphone and have access to typical wireless functions, and they can communicate across the commercial networks and back to their own private LMR system. The theory is that many companies with LMR systems will, over time, move solely to POC and abandon their LMR system altogether. There are several success stories of companies that have deployed with this strategy and won large contracts over the past year or so. One of the most successful companies in the POC application space is SLA Corporation with its ESChat product offering.

Knowing When POC Is a Solution and When It Is Not

Many PTT or POC providers assume their technology can actually replace the land mobile radio systems deployed by the Public Safety community for dispatch, day-to-day operations, and during emergencies. This is simply not true! These LMR systems will remain in place for a long time because they are much more robust and fault tolerant than commercial networks. During times of large-scale incidents, commercial wireless networks tend to become overloaded and as a result, many customers cannot access the network. Obviously, this is not acceptable for the Public Safety community, especially since there are no provisions for priority access for the Public Safety community in the commercial wireless world.

However, while this is true and correct, it does not allow for the fact that there are opportunities for POC to be deployed within the Public Safety community. Once vendors realize dispatch and mission-critical services are not well suited for replacement by POC, they will discover that there are a number of other uses for POC within the Public Safety community that make perfect sense. SLA Corporation

understands the differences between mission-critical dispatch communications and non-mission-critical or administrative communications.

For example, a large number of Public Safety administrative personnel who work at desks or out in the community are not considered first responders. Today, many of these people must carry both a smart wireless device and a handheld PTT radio in order to stay in touch with their agency. This group is ideally suited for POC since with POC they could carry a single device and, just as important, the handheld radio would not be interrupting their work or conversations but they would still be in instant communications with their agency.

Another group of people who can and do benefit from POC is made up of off-duty but on-call personnel and those who want or need to be aware of what is happening within their agency. With POC it isn't necessary for these people to carry a handheld radio as a second device. And then there are detectives and plain clothes personnel who need to be inconspicuous, and in some cases need to be able to communicate with others but don't want to listen to routine communications traffic or have their radio blast out a dispatch as they are engaged in a covert operation.

Another valid reason for making use of POC within the Public Safety community is that it is easy for citizens to monitor the two-way radio channels employed by most departments. While encryption is being used more and more, there are still many agencies across the United States that can be monitored using an application on a smartphone or an inexpensive radio scanner. A really good POC application will include high levels of voice encryption to ensure privacy during communications.

Other potential customers for a good POC multi-network solution include utility companies, transportation companies such as trucking, taxi, limo, and perhaps even services such as Uber. Healthcare providers are a significant group of PTT service users as are construction workers, many types of educational institutions, especially schools with school bus services, and the hospitality industry. Many of these organizations are already familiar with PTT since they have previously used land mobile radio and/or Nextel PTT services. The fact that even those who use LMR PTT services today also carry a smart wireless device for use over the commercial wireless networks is one of the most compelling reasons for switching to POC.

Today, the push-to-talk over cellular or POC marketplace has many apparent contenders. However, once you look at what it takes to be a serious contender in the POC market, the number of potential competitors shrinks. In this market it takes more than a simple application that provides push-to-talk-like service over one or more network to be truly competitive. First, of course, is the issue of time it takes to set up the call and then the volley time or time between responses, both of which are critically important, especially for those who have been using push-to-talk over land mobile radio systems or Nextel. The premise of PTT service is that it is near instantaneous and provides access to one or many different people at once. If there are setup delays or if people have to wait for some period of time after the transmission before they can respond, they simply won't use the system.

A PTT system needs to have many other attributes beyond the time it takes to start and continue a PTT conversation. The word "system" rather than "application" is appropriate here because in order to provide the types of services expected by existing and potential PTT services, it is important that the PTT vendor provide best-in-class voice quality, which requires the use of variable rate codecs and error correction. The system must be flexible and enable one-to-one and one-to-many communications between and among existing LMR radios, the dispatch center, and POC users. The experience must be seamless, easy to use, and without any type of system delays.

The features outlined above are only a small portion of what needs to be available to provide services for the customer base. Today, location on a near-real-time basis is vitally important and must be shared across all of the platforms, and text messaging has also become a must-have. Perhaps the most important requirement for POC vendors is to provide interfaces not only to LMR analog radio systems, which have been in existence for more than thirty years, but also to the newer digital voice systems. This includes the P25 standard for Public Safety as well as DMR, NEXEDGE, MOTOBRO, TETRA, and others. The type of voice network the POC device it is interfaced with should not matter. It simply must work.

Beyond these absolute requirements are others that enable users to define groups of people to be included in a PTT conversation while excluding others. The number of groups and the size of each group varies from vendor to vendor. However, the larger the organization to be served with PTT, the more flexibility is required when it comes to groups and the number of individuals within each group. When group technology was first offered by Nextel it had to be set up on a PC, so building new groups was awkward. Today, groups must be able to be created from the device and on the fly so there is flexibility in how people communicate. In many cases today, groups are defined not only within a single organization but also between organizations. For example, a County Sheriff's key personnel might have a POC system tied to their own dispatch and LMR systems and another group that provides interoperability between the County Sheriff and various local police departments, or perhaps between the Sheriff and the fire departments. One of the major issues for Public Safety LMR users is that they often cannot communicate between agencies during emergencies. However, the POC system can bridge this gap and provide an additional level of coordination. The caveat is that commercial networks have not been designed to provide mission-critical communications and during times of large-scale emergencies commercial wireless networks may not be available for Public Safety use. Thus legitimate POC vendors will not try to convince Public Safety agencies that they can replace their day-to-day LMR dispatch systems.

The advent of commercial broadband services has been seen by a very few POC vendors as an opportunity to enhance their product offerings by adding features and functions. The push-to-talk systems used from the 1930s until the early 2000s have given way to much more robust offerings and have empowered customers with features and functions they have come to rely on. Today's PTT over cellular matches the advanced functions found on the most modern land mobile radio systems.

However, since POC is based on broadband technologies, POC is able to add features and functions that are not available over LMR PTT systems today.

The Market for PTT

In 2005, Nextel had more than 20 million subscribers on its cellular network and PTT service offering. Including Public Safety's 4 to 6 million PTT land mobile radios, there were reportedly an additional 50 million PTT LMR users in the United States. Today these numbers have dwindled considerably. However, while land mobile radio continues to lose customers, the commercial wireless PTT market is growing at a similar pace as many ex-Nextel customers search for options, companies with LMR systems explore their options, and Public Safety and other agencies turn to POC to off-load administrative and non-essential traffic in order to free up their oft-times overloaded mission-critical networks for dispatch and emergency calls.

The total available market for POC is difficult to quantify because it not only includes ex-Nextel customers and those making use of LMR systems but others who, through marketing efforts, will be exposed to POC and find it can be beneficial in assisting them in their daily lives. So far, most of the marketing efforts have been aimed at ex-Nextel and existing LMR users who can be considered "low hanging fruit" because they are already familiar with PTT and its advantages. However, over time, companies that want to thrive and grow in the POC marketplace will branch out to educate many companies that have never experienced PTT and then sell POC services to them.

One of the advantages companies such as SLA with its ESChat solution has is that it works over multiple networks and Wi-Fi as well. The big three commercial network operators have built PTT into their networks but because the PTT technologies are different, there is no really good way for them to offer PTT across multiple networks. PTT needs to be network agnostic if it is to gain market acceptance. All you have to do is to look back in time to understand that technical advances became mainstream only after they were available across networks. This was true with text messaging (SMS) and Multimedia Messaging Services (MMS) that enable attachment of pictures and other content. In some ways this also applies to cellular voice, which grew slowly until roaming agreements between networks were in place. As long as network operators do not provide cross-network PTT services, ESChat and other "over the top" POC services will continue to have a decided advantage.

Push-To-Talk Standards

As mentioned, today there is no one standard for push-to-talk over cellular. Two competing organizations are currently working on a standard. The first is the Open Mobile Alliance or OMA, which does not appear to have the support of the network operators or many of the existing POC vendors. Another is the 3GPP, which is the standards body that has published the standards for fourth-generation LTE technology. The 3GPP has included a PTT standard in its work product that will be finalized and released in the next year or two but won't be available for commercialization until at least 2018.

Further, since the 3GPP standard is an LTE standard it is doubtful that it will be backward compatible with existing 3G systems. Since 3G systems cover more of the world than LTE systems today, having an LTE-only standard will not provide the same level of PTT coverage as existing services that work on both 3G and 4G networks. Again, the best way to promote push-to-talk over cellular is to make it available across all networks as well as Wi-Fi. Network-centric solutions are proprietary and prevent customers on different networks from taking part in PTT conversations. This makes it especially difficult for those trying to manage "Bring Your Own" device programs within corporations.

Perhaps the most important must-have for a serious PTT vendor is the ability to connect POC and existing LMR systems together. This is important for a number of reasons. First, if a company wants to try it out to see if POC meets its needs it can keep its LMR system up and running. By running both systems, it can provide POC devices to executives and some of the workforce and let them try the service while staying in touch with those using the company's LMR system. For Public Safety, enabling senior officers to carry a single device and still stay in contact with their dispatch center or talk via their POC devices over one of their LMR radio channels is a must. Further, detectives and others who might be in undercover operations certainly do not want to be seen with a two-way radio on their belt even though they still have a need to talk among themselves and oftentimes back to the dispatch center or directly to incoming units that are on the LMR system.

SLA's Push-To-Talk over Cellular (POC) Solution

As mentioned above there are many contenders offering various types of POC services. Some services are even offered for free, but very few of the serious contenders can provide all the features, functions, and flexibility needed for a great user experience and POC flexibility. SLA's ESChat is one of the best examples available today for a POC system that meets and exceeds all the requirements spelled out above. ESChat was not designed for friends and family use but rather to replace and/or augment existing professional grade PTT services. It is robust, secure, and can be configured in many different ways to provide even greater levels of security, making it an ideal choice for government entities as well as businesses concerned about security.

Some companies that supposedly compete in the POC field simply provide an application that functions like a poor man's push-to-talk with few features and slow response times. SLA, on the other hand, provides more than an application for a host of devices including Apple, Android, and Windows devices. It is a system that includes back-end infrastructure to secure the communications, manage the devices, provide interfaces between various voice protocols, and much more. ESChat can be deployed making use of the SLA servers so no infrastructure is required at your location. It can be deployed using hosting options including Amazon AWS Cloud and for government entities and the Amazon AWS GovCloud, or SLA can provide on-premise infrastructure for those who want complete control over their POC system. Moreover, ESChat can be installed in closed and secure networks run by third parties or customers themselves without using the Internet for connectivity.

When the system is installed, clients are installed on the devices, and the POC connection is made. ESChat is easy to use, it supports secure PTT voice, secure text and image messaging, and real time (live) as well as historical location tracking and mapping. This last feature enables clients to track their units in the field and, when necessary, backtrack to see where they have been.

The SLA system is secure from end to end, and this includes the smartphone devices used in the system, the connections to and from existing Public Safety or business LMR radio networks, and secure communications between the POC devices and dispatch consoles. In many cases, SLA is also able to integrate its solution with existing Computer Aided Dispatch (CAD) systems.

SLA first deployed ESChat in 2008 on the Verizon Wireless network for a military installation that needed more PTT functionality than that offered by Verizon's own PTT service. SLA has continued to upgrade and enhance ESChat so it works well across LTE (fourth-generation technology) and Wi-Fi, and it is still backward compatible with existing 3G networks. While Verizon also offers its own "baked into the network" PTT solution, it continues to provide ESChat to its customers and enables Verizon customers to add ESChat's service charges to their Verizon bill. Further, ESChat is available to all government agencies because it is approved for purchase by the GSA (General Services Administration), as well as directly from SLA Corporation. SLA also provides support for third-party developers that want to build on top of the ESChat functionality. Included in this support are an SDK available for third-party integration that provides access to Apple devices (iOS), Android Devices, and PCs, both as a client and a dispatch tool, and ESChat is easily integrated with most existing dispatch consoles and Computer Aided Dispatch (CAD) systems.

PTT Features and Functions

As land mobile radio evolved from analog to digital, PTT capabilities increased as well. In the earliest days of PTT, everyone on the same LMR radio channel heard all of the PTT traffic on that channel, even traffic that was not directed to them. Today, LMR PTT services include fully encrypted PTT, the ability to divide the PTT population into various groups and sub-groups, and in some cases the ability to track the location of a user or vehicle with GPS tracking. Companies such as SLA with ESChat have not only provided all of the features and functions available over LMR for PTT, they have provided even more functionality because of the advanced capabilities of 3G and 4G broadband technology. Some of these features are secure group multimedia text and image transmission and live mapping and tracking of device locations including being able to track devices back in time.

There are many more features and functions provided by ESChat (see Appendix A), but the bottom line is that SLA started with a basic, very fundamental form for voice technology and enhanced it in many different ways. Today, POC features go well beyond what is available with the most modern Public Safety digital networks, primarily because of the added bandwidth and capacity provided by today's commercial broadband technologies.

ANDREWSEYBOLD

POC Contenders

The POC market is crowded with companies that all claim to have the best solution. As mentioned, AT&T, Sprint, and Verizon all offer their own proprietary flavor of a networked-based PTT service that is not compatible with services offered by the other two network operators. When it comes to POC services based on applications and non-network-specific back-end infrastructure, there are a number of contenders but only a few truly understand all of the requirements and implications of providing POC services across multiple networks with the ability to cross-connect with multiple types of LMR technologies, both analog and digital.

In the early days of push-to-talk over land mobile radio it was not possible to determine who was active on the network and who was not, where he or she was, who was making the call, or even to confine the conversation to a few people within a workgroup. Today, using both third and fourth-generation commercial wireless technologies, PTT over cellular has been enabled by companies that truly understand the needs of the customer and that go well beyond PTT services offered by LMR. In order to be a true contender in the POC field, you not only need a fast PTT service with almost instant call setup and near instantaneous response from other users, you need to provide, at a minimum, the following features.

Security. While both the 3G and LTE networks of today include basic encryption, they are not as secure as they need to be. Therefore, any POC vendor must provide a high level of data encryption without impacting operation of the system. The current acknowledged best level of encryption available today is AES-256. Further, if the POC system is capable of text and image messaging, a real differentiator in many cases, these too must be secure.

Location-based services. There is also a suite of features that really set the vendors apart. These are centered around location-based services, including real-time live location of group members, the ability to backtrack their travel history, and the ability to tell who within the group is available and on line and who is not.

Groups. The newer land mobile radio technologies provide for groups of users to be created so a caller can address only a specific group, subgroup, or individual, and the desired number of groups and the number of users within each group should be provided for by the vendor. The ability to create groups, add to groups, and delete groups on the fly is also a requirement for a true POC contender as is a dispatch client that can reside on a PC located at a dispatch center to keep track of the users, their locations, and status. In short, what sets one POC vendor apart from the rest is end-to-end solutions that provide advanced features and functionality via commercial and Wi-Fi wireless connections that can be fully integrated with existing land mobile radio systems.

Back-end. Since a back-end system is required to manage the POC system, the location of this back-end infrastructure should be flexible. For companies that do not want this equipment on premise, a cloud-

based solution should be available, and for organizations that want to host the entire solution, the servers should be capable of on premise location and operation. Many organizations do not trust cloud-based systems today, nor do they necessarily trust connections that rely on the Internet for access. SLA provides customers with a choice of several cloud-based systems, self-hosted systems, and systems that can be deployed making use of secure IP networks that do not touch the Internet. Flexibility in system design and the ability to quickly and easily connect LMR and ESChat systems together, as well as the advanced features of ESChat, has resulted in a large number of corporate, Public Safety (non-mission-critical), and federal government wins.

Interface. One of the most important aspects of POC is the ability to provide an easy-to-use interface between the POC system and existing land mobile radio system. In the LMR world there are a variety of systems that might need to be interfaced to the POC system. These include Analog FM, which is still used in more than 50% of law enforcement, utilities, taxis, and other land mobile radio users. Then there are the new digital technologies including Public Safety Standard P25 and several competing lower-end technologies being employed mostly by business users. These include DMR, NEXEDGE, MOTOTRBO, and a few others.

LMR connection. The ability to connect to existing LMR PTT systems is vitally important to customers looking for an extension of their existing LMR systems and/or if they want to phase out their LMR systems over time. The beauty of a gateway between an LMR system and a POC system is that those carrying POC smart devices do not need to also carry an LMR radio. Further, since they can use POC no matter where they are as long as they have wireless network coverage, POC actually extends the range of a standard LMR system that is usually limited to a 30 mile or so radius out to the coverage provided by the commercial wireless systems. This means coverage virtually anywhere within the United States, and, in fact, most places around the world. Since ESChat does not rely on embedding devices, infrastructure or even software within a network's framework, it does not rely on expensive back-end system add-ons such as IMS (IP Multi-media System) nor does its deployment require customers to enter into any special contract with the network operators. Since ESChat is essentially a wireless data IP-based system, it is simply counted as data service usage by the network operator, lowering the per-unit cost of the system roll-out.

ESChat Customer Base

SLA makes it clear that it did not develop ESChat as a friends and family POC product. A number of supposed contenders do market or even give away a POC application designed for the family and friends marketplace. Instead, SLA's ESChat is designed as an industrial strength full end-to-end POC system that is virtually as fast as PTT services over existing LMR networks. ESChat has been designed to fit into the high-end, existing PTT marketplace as both a replacement for non-mission-critical PTT LMR services and to augment existing LMR PTT services. There is a possibility, over time, that PTT will become mainstream and even sought after by the younger friends market that enjoys chatting one-to-many over text. Using

POC could add one-to-many voice. However, the cost to penetrate this market, which means creating a buzz for a technology that has never before been used by a younger generation, is most likely not worth the money, time, or effort because PTT is foreign to them and difficult to comprehend.

Today SLA's ESChat is enjoying an ever-increasing customer base. In February 2015, ESChat was the PTT of choice for the first real test of FirstNet's 700-MHz Band 14 spectrum. In Vail Colo., General Dynamics added four Band 14 LTE eNodeBs to augment the existing Crown-Castle system that integrates all of the network operators, Public Safety, and Wi-Fi service. Operating ESChat on Sonim XP7 Band 14 handsets, first responders at the International Ski Federation (FIS) Alpine World Ski Championships were provided with unencumbered FirstNet spectrum, moving POC one step closer to providing mission-critical communication. After the event, the Task Lead for communications praised SLA and ESChat for the way in which they provided PTT services across the Band 14 FirstNet during the event as well as the level of support SLA provided.

While conducting due diligence for this paper we contacted a number of SLA clients, many of which have been customers for multiple years and some that have already renewed their contracts with SLA. It is not unusual for a company's chosen customers to answer in the affirmative when asked about the service and the support offered, but what we found most interesting was the fact that in addition to simply answering the questions we posed to the clients, many went above and beyond in their responses to us. Not only did they indicate they were happy with the service and support but they were very satisfied with virtually every aspect of their deployment from the upfront planning to the implementation, training, operation, and follow-up support provided by SLA. We have included a few of the comments from SLA's customers in Appendix B. One of the questions we asked was whether they had PTT experience before contracting with SLA for ESChat. Most of them had, usually as Nextel clients who lost their service when Sprint turned off the Nextel network and opted not to make use of the Sprint proprietary network. This is largely due to the fact that ESChat works across multiple networks including Wi-Fi while the commercial network versions of PTT only work across their own network. In today's environment of "Bring your Own Device" (BYOD), the likelihood of employees being on the same network is low. In this situation, customers wishing to deploy PTT only have two options. One is to sign a contract with one of the top three commercial wireless network operators and then provide devices on that network to all of the employees who will need PTT and the other is to contract with a company such as SLA with ESChat to provide PTT services for all of the different devices used across the networks without having to spend additional money on devices on a common network.

The PTT Competitive Landscape

There are a number of things that should be carefully considered when choosing a PTT services provider. Among these are whether the system runs over multiple networks with Wi-Fi being a bonus, and if it can be downloaded onto most devices so you are not required to buy new phones. Also consider whether it provides both voice and text PTT-type services that are encrypted using the latest recognized encryption techniques, and if it is flexible as far as the number of devices, the number of talk groups, and how the back-end system is configured and implemented.

In Appendix A you will find a checklist of features and functions offered by SLA for its ESChat POC solution that might be helpful when comparing competitors. You will want to try out the service and compare the speed of the PTT system. There are several speeds that are important to consider. The first is called the "setup" or attack time, which is the time it takes to start a PTT session. This does not include selecting a group or individual but it does count the time between pushing the PTT button and when you can start talking. You will usually hear a beep sound when the network is ready for you to start talking. If you speak too early, the person or group you are calling could miss some of the words. A good POC system should take less than a second for the setup or attack time.

Next is what is called the "volley time," which is the time between when you end your PTT message and someone else can respond to you. This time should also be less than a second. PTT services are meant to be fast, with little or no delay, and enable you to hold a conversation back and forth without the frustration of having to wait. However, once in a while you might have delays that will be attributed to the loading of the network and not the technology you are using. During peak hours or emergencies, it is possible that you won't be able to gain access to the network in a timely fashion. This is one reason POC is not suited for mission-critical Public Safety.

Finally, you need to conduct a voice quality check. Can you recognize the speaker's voice? Can you hear in a noisy environment? Is voice clear and easy to understand? Your POC provider may not pass this last test, but it does not mean it is not providing excellent service. We use this test to measure the true network speed. As soon as we push the PTT button we say, "Don't Shoot!" and then we check to see what the person receiving the PTT message heard. Obviously, if the first word was cut off, that is not good. With ESChat we found that once the first beep is heard the system is ready and very quick.

Conclusions

The number of providers of "over the top" application-driven PTT over cellular can seem to be overwhelming but once you do a little research it is easy to understand that there are only a few viable options. Of the few true competitors, our findings are that SLA's ESChat is the top contender when it comes to setup, ease-of-use, voice quality, system flexibility, voice and data security, and system cost factors. The network-specific PTT options appear to be less expensive but remember that if you have many different devices on different networks, only the devices supported on that specific network will be capable of PTT service.

Network operators have built the back-end infrastructure into their networks so their pricing may appear lower. However, the trade-offs are that you are now captive to that specific network and the devices it supports, and that any changes the provider might make in the future may impact the system operation or the types and number of devices you are using. The alternative, an over-the-top application and end-to-end system such as the one offered by SLA will work across all of the commercial networks as well as Wi-Fi, it will remain viable and up-to-date, the choices for hosting the back-end are many, and the price points will differ depending upon which hosting option your choose.

If you choose to host the system at your own facility, using servers that are onsite, the pricing from SLA will be higher than if you take advantage of one of its two cloud hosting options (both from Amazon), one geared for business entities and one that is, perhaps, more secure and designed more for governmental agencies. Regardless of which hosting option you choose, you always have the option to change to another back-end configuration later if your needs change. In the meantime, pricing for the remote hosting systems is very reasonable.

Again, we believe the real key to a successful POC implementation is the ability to use virtually any device across any network and end up with a seamless POC system where all devices can communicate with all of the other devices and access to existing land mobile radio systems is easy to set up and easy to use for those who need LMR. The convenience of being able to carry only one device, and to mute your LMR PTT traffic until and unless you want to hear it and communicate with your LMR users, is a big advantage over carrying two devices.

SLA's ESChat is used widely by a variety of clients, from smaller business clients to large national organizations, from a single Public Safety agency to a group of agencies that use POC to enhance interoperability between different jurisdictions, and by the military and other federal government agencies. SLA has been making enhancements and providing upgrades to its system since its release in 2008, and the customers detailed in the Appendix are all pleased with the system, its cost, and the flexibility it provides. Many of these customers have integrated their LMR and POC PTT systems to provide access to LMR users from POC users and from anywhere there is network or Wi-Fi coverage. Not only is this cost effective, it is provides a way to contact senior executives when needed, no matter where they are.

Placing standard voice calls is relatively slow and cumbersome, even when using speed dialing. Further, the standard telephone call is designed to be one-to-one in nature, and one-to-many calls usually require previous arrangements such as setting up a conference bridge, sending out the contact number and a time, and hoping everyone can attend. It is a lot easier to look at your wireless device, see that those you need to talk with are available, select the group that fits, and simply depress the push-to-talk button to speak to them all at once.

Those who have never experienced PTT have no idea what they are missing. Those who had PTT via Nextel or their own LMR system but have stopped using it, miss it. When they find out there are options out there and that one works across every network and Wi-Fi, they are quick to sign up and get back to a tool they know saves time and money. PTT really does provide an edge over dial-up voice and it gives the vendor an edge over other non-PTT equipped competitors.

In the world of push-to-talk over cellular, ESChat stands out from the crowd. SLA seems to have a better grasp of what customers truly want from a PTT system, and from what we have seen, the systems it has delivered using ESChat have worked as advertised. SLA's ESChat customers are very happy; many have renewed the service at least once and several of them multiple times. This is a powerful testament to the fact that the ESChat solution works and works well.

Appendix A: ESChat Features and Functions

Core Features

The ESChat product is differentiated from the competition in a number of ways. From an operational perspective, ESChat supports four core areas of operation:

- Secure push-to-talk voice
- Secure group multimedia messaging (text and images)
- Live mapping and tracking services
- Historical (bread crumb) tracking

ESChat enables users to communicate on a 1:1, ad hoc, and Group basis. ESChat provides eight distinct Talk Group types each customized to fill a particular mission. Talk Groups range from the basic Nextel-type Group to Groups for Surveillance, Command, Dispatch, Unicast, Emergency Broadcast, and more. Each multi-way Talk Group will support 250 members while the Emergency Broadcast Groups can reach up to 60,000 users with the press of a single button.

Common Applications

First responders can fully integrate ESChat with Dispatch Consoles or Computer Aided Dispatch (CAD) as is the case with American Medical Response (AMR), the largest medical transportation company in North America. Common applications for law enforcement users include Dispatch, Command, and Tactical, each of which has a distinct set of needs that are fulfilled by ESChat. School districts use ESChat for managing maintenance operations, transportation, and emergency communications. ESChat's integration with Land Mobile Radio provides (LMR) seamless communication between LTE and LMR-based users.

A Complete Communication Suite

ESChat is a complete solution that includes endpoint access for Mobile Devices, PC Clients, LMR, and Console systems. ESChat service can be hosted from the Amazon AWS Standard Cloud, Amazon AWS GovCloud, the customer's private cloud, or internal network servers.

ESChat customers on the AWS Standard Cloud take advantage of service availability from any of Amazon's five hosting Regions around the world. 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 a real-time mirror across the Availability Zones, so in the event of a network failure, ESChat services will continue without interruption to the customer.

AWS GovCloud (US) 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, or low-cost non-redundant servers where high availability is not a priority.

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.

Hierarchical Structure

The ESChat User and Talk Group structure includes a hierarchical structure where each individual and Group has an associated Priority, thus enabling ESChat to provide Preemption. Preemption can occur within an ongoing Group Call, allowing a high priority user to 'step on' or take the floor away from another user. Preemption can also occur on a Group basis, where, for example, all members of an ongoing Group call will be joined into a higher priority or emergency call. An individual can also preempt a member of an ongoing Group call 'pulling' a single member from the Group call and putting them into a 1:1 or ad hoc call.

Presence for Users and Groups

User Presence is displayed for all individuals within the Contact List. ESChat has adopted the Microsoft Lync or Communicator color codes for Presence, with a few additions to accommodate wireless operations. ESChat's presence can be tied to the phone's status, so indications for Do Not Disturb (DnD) and Silent do not need to be doubly set. ESChat also includes Group Presence that shows whether a Group Call is in progress. This feature is useful for large groups, for users joining late call, or re-joining a call. Without an indication of the Group, call status can mean the difference between a user being the 200th person to join an ongoing call or the user alerting 199 other users that he/she wants to start a new call.

Common Operational Picture (COP)

ESChat is used by the U.S. Military and law enforcement agencies at the federal, state, and local levels. ESChat is also popular with multi-jurisdictional and multi-agency taskforces that benefit from ESChat's Common Operational Picture. Teams engaged in tactical operations are able to reliably communicate, share Text and Images, and view real-time location of all team members. This enables team leaders to reposition members and script or whiteboard activities. The Common Operation Picture is one reason ESChat maintains its position as the top PTT solution available today.

Feature Keys

The ESChat system is feature keyed so each agency can customize the desired features on a section-by-section basis. For example, while command or management may need to view the location of staff or field users, the converse may not be true. ESChat enables customers to configure Profile Templates that can be assigned to sets of Users. Profile data is pushed to the user devices Over The Air (OTA) so all changes to the network configuration can be performed without the need to 'touch' the devices. Every top level feature down to every item contained in every menu within ESChat can be managed via the Feature Key system.

Voice Codecs

ESChat uses the Opus Voice codec (Encoder/Decoder) to provide the highest possible voice quality for its users. The Opus codec has been standardized by the Internet Engineering Task Force (IETF) as RFC6716 and has incorporated technology from Skype's SILK codec and Xiph.org's CELT codec. ESChat operates Opus over varying bitrates depending on the available network technology at each endpoint. Quality of

signal and other considerations are constantly evaluated during calls to determine each endpoint's bitrate. Where down-conversion is required, the ESChat transcoder performs the process so users in less ideal conditions can maintain the best possible voice quality.

Voice Quality

Voice quality in the telephony industry has traditionally been measured in terms of Mean Opinion Score (MOS). Once an actual opinion of human test subjects, MOS testing has been replaced with objectively performed audio tests known as "Perceptual Objective Listening Quality Assessment" (POLQA). POLQA testing is performed using precision audio test equipment that transmits and receives a set of industry standard audio phrases and compares the quality of the received audio against the transmitted audio. MOS and POLQA are measured on a scale of 0-5, and standard cellular voice quality under good wireless conditions is typically in the 2.9 range. ESChat has been tested for POLQA in the controlled environment of the Verizon Wireless test laboratories. Measurements were performed over a wide range of 4G LTE wireless conditions using an Audio Precision APx525 test set. Baseline testing provided a maximum possible score of 4.56, and ESChat testing resulted in a POLQA/MOS score of 3.94.

PC Dispatch

ESChat Dispatch is a PC Application that runs on a Windows-based desktop or laptop computer. ESChat Dispatch is an easy to deploy method to enable customers to add a fully functional dispatch solution that can be connected via hardwired Internet or operated remotely on an AirCard-enabled laptop as part of remote command or agency disaster recovery infrastructure. ESChat Dispatch is fully featured and includes secure PTT voice, multimedia Group messaging, and live location display. Operators can choose from numerous USB audio headsets or desktop microphones, some that include an integrated PTT button. Optional USB footswitch pedals can also be used as a PTT key.
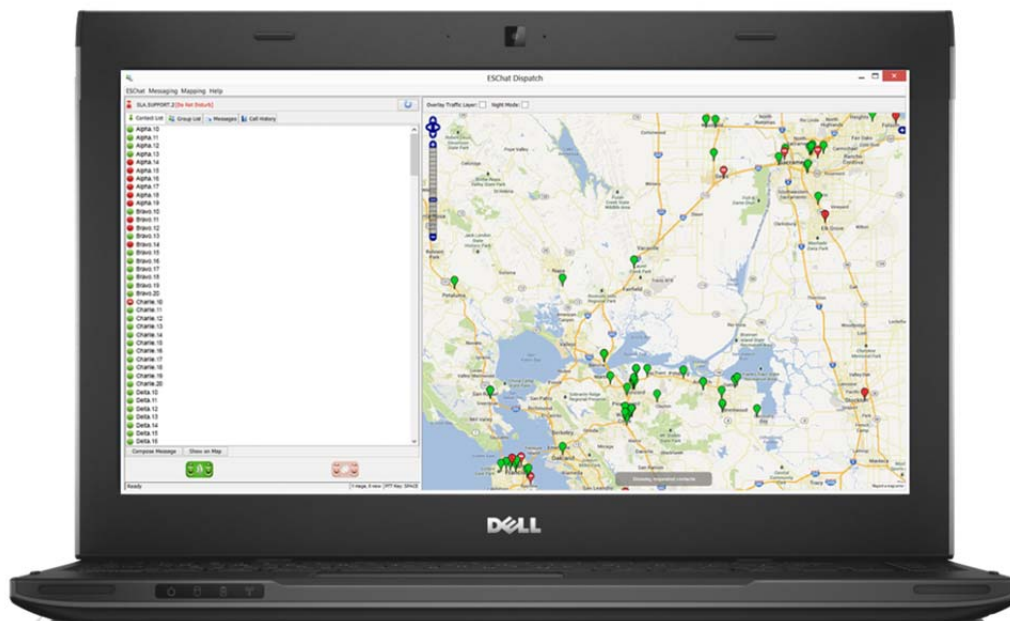
Integration

The integration of ESChat cellular users with LMR users opens a wide range of options for end users. The common objectives if LMR integration include:

- Adding capacity to an LMR network without adding LMR infrastructure
- Extending the coverage area of an LMR network
- Unifying PTT communication from numerous LMR networks
- Providing a means for command staff to monitor and communicate while out of LMR coverage
- Adding the ability to carry a single device where non-mission-critical communication is required.

ESChat began offering LMR integration in 2009 via standard 4-wire E&M interface. Systems such as the Motorola SmartZone were common targets for ESChat integration due to the high cost of infrastructure expansion. The 4-wire E&M interface remains a popular choice in 2015, as it provides a means for reliable, low-cost group-oriented LMR to cellular interoperability.

SLA now offers advanced interface methods to LMR and Console networks including ISSI and AIS. These interfaces have been under development by various radio manufacturers and other stakeholders, and allow POC devices to not only communicate with LMR users on a Group basis, but also on a 1:1 basis. Therefore, a single cellular ESChat user can communicate with a single LMR user and maintain end-to-end encryption. The new interfaces also provide a means to take advantage of the advanced features of many new radio systems including GPS location and text messaging. As such, ESChat users can now also view the location of all LMR users, enhancing a Common Operating Picture.

SLA has created strategic partnerships with third-party integrators, through which ESChat can communicate on Kenwood's NEXEDGE, Digital Mobile Radio (DMR), TETRA, P25, and others. As members of APCO International and the DMR Alliance, SLA remains committed to continuing growth through partnerships and continued integration with emerging standards.
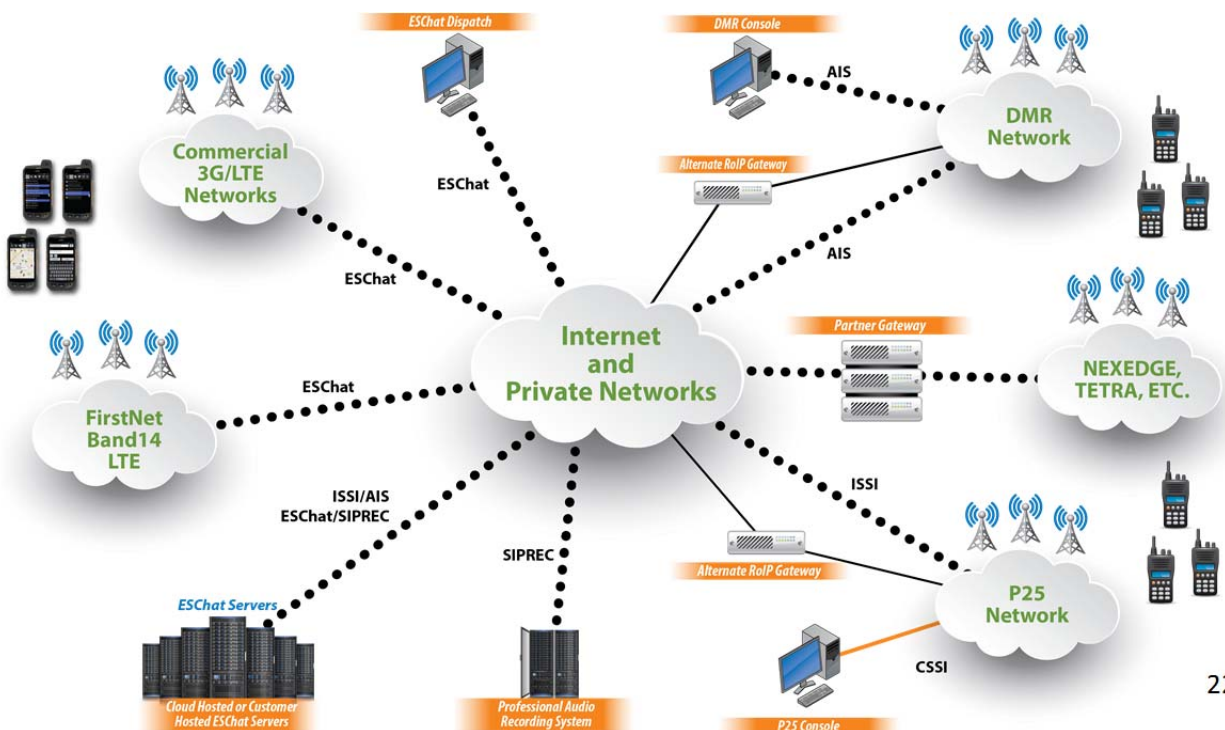
Security

ESChat employs AES-256 encryption for PTT voice, Messaging, Location, and signaling data. A standard and an enhanced security model are available for customers to select during the provisioning process. Enhanced security requires that a 'Trust Officer' validate a match of the server and device public key hash after the initial key exchange occurs. This Trust stage ensures a device that was activated is not impersonating or 'spoofing' another user's account. Once trusted on the ESChat network, all calls are performed with ephemeral encryption keys so no two calls ever use the same keys.

All PTT calls within the ESChat ecosystem are encrypted from end-to-end. The native ESChat endpoints include smartphone and tablet devices, personal computers and LMR gateways. There are three methods available to maintain encryption between ESChat and encrypted LMR networks such as P25 and DMR. The most common of these methods is to operate the ESChat and LMR networks as separate encrypted systems and bridge the two together with a decrypt and re-encrypt function that takes place in a secured envelope of the LMR network. This method is reliable and inexpensive to implement. The other methods also provide end-to-end encryption but do not have the decrypt/re-encrypt stage. While this does offer some benefit, it also forces use of the royalty bearing AMBE codec, thus increasing the overall cost of the push-to-talk over cellular system.

In certain customer deployment scenarios where SLA is considered the 'Carrier,' ESChat users are subject to CALEA laws similar to standard cellular calls. Therefore, in the event SLA is presented with a lawful intercept order, ESChat secure communications are subject to wire-tap.
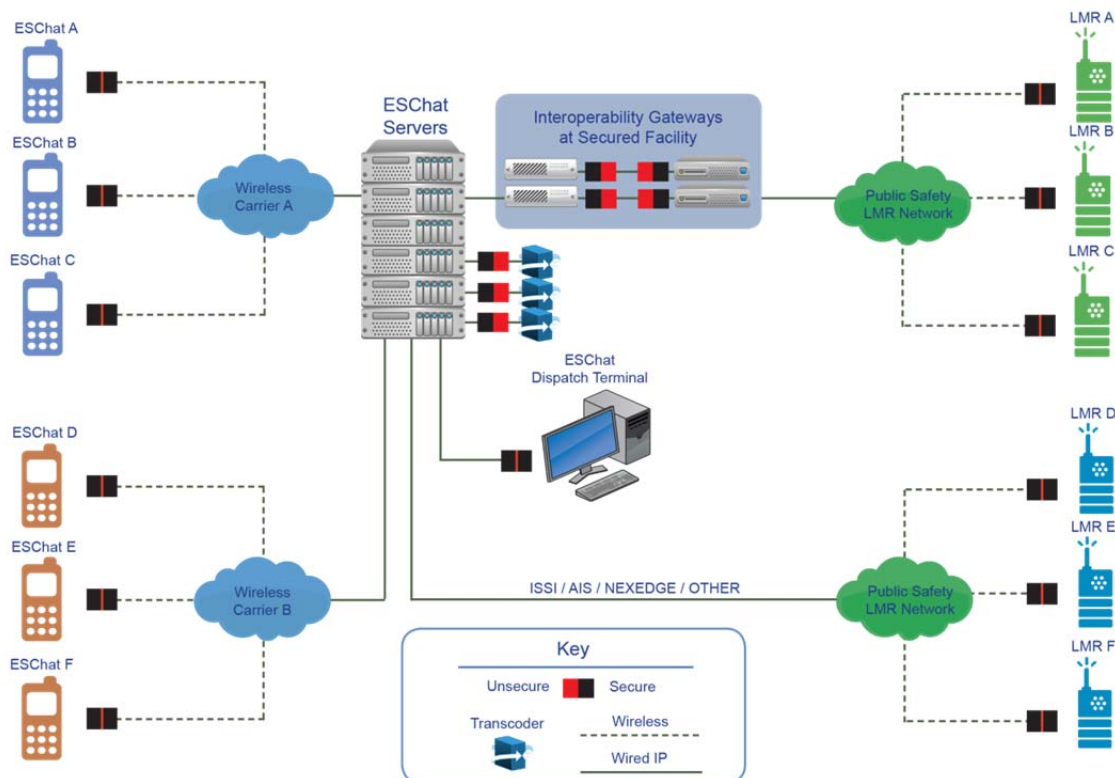
Partnerships

SLA's partnerships also include device manufacturers. One of note is handset manufacturer Sonim Technologies. ESChat is fully integrated in the new Sonim XP6 and XP7 ultra rugged Android handsets. Currently offered in the United States and Canada, these devices provide the reliability and feel previously offered only in LMR radios. Built for PTT operations, the XP6 and XP7 devices include a dedicated PTT button, high-capacity battery, fast acquisition GPS, 103dB speaker, and are designed to support Band 14 (FirstNet) spectrum. The Sonim devices also come with a three-year unconditional warranty.

For third-party developers that want to add secure PTT into an existing product, ESChat offers a series of Software Development Kits (SDKs) for iOS, Android, PC, and Console development. ESChat service can be run from the Cloud servers and re-sold by the developer. Optionally, the developer can host its own instance of the ESChat servers in its own Cloud or managed hosting facility.

Peripherals

ESChat includes a complete set of peripheral devices that include Bluetooth and wired headsets with integrated push-to-talk buttons for covert operations as well as amplified Bluetooth and wired Remote Speaker Microphones (RSMs) for roadside and other high noise environments. These options along with vehicle mounting kits enable commercial customers to legally operate within the rules as defined by the U.S. Department of Transportation Federal Motor Carrier Safety Administration.

ANDREWSEYBOLD

Appendix B: ESChat Customers and What They Say

Below are a few of SLA's customers and their comments about both the technology and the company. In these quotes you will notice there is no customer agency or name because we were asked to keep those specifics confidential. However, in each case we verified the comments and we have vetted these customers of SLA.

Customers Confidential – Large Medical Transportation Company

With more than 16,000 employees, this company serves more communities and customers than any other private ambulance service provider. It has been using ESChat for more than two years and currently has more than 1,100 active lines with additional lines being added each month. It operates Ambulance and Paramedic services across North America so having a common POC system has proven very helpful to its operation. It also has multiple LMR systems and in response to the question about POC and LMR systems being linked, the response was, "Not presently." When It was asked why it chose to augment its LMR system with ESChat its response was, "We wanted a redundant system that was not dependent on our internal infrastructure. ESChat offers us a secure system that we can access from anywhere."

"When making their decision, we evaluated the systems available from each of the network operators as well as others and decided that ESChat best met its needs. As it stated, the following was the basis for this purchase decision. "We had experienced proprietary, carrier-dependent PTT solutions in the past. The challenge for our organization is that there is not a single cellular carrier that works everywhere we operate. We needed a solution that would allow us to:

1. Provide cross carrier communications across all commercial networks
2. Have independent control of talk groups without having to call the carrier to make changes
3. Ability to add/remove groups as needed for short-term events
4. Ability to add/remove devices on an ad hoc basis without having to involve a third party
5. Seamlessly integrate into our existing dispatch consoles

It is using ESChat across multiple, different networks, with no reported perceivable difference in operation. When asked if it would recommend ESChat and SLA, its response was, "I regularly recommend ESChat without hesitation. In addition to all the items listed here, their customer service has been phenomenal. We are known for searching out new ways to use ESChat. The team at SLA is always responsive and has been able to accommodate every request."

Customers Confidential – Large Towing Industry Customer

ESChat is currently used by multiple large scale independent towing companies across the nation. Some of the larger regions cover multiple states, and operate with hundreds of ESChat users on its system. The customer did have an LMR system statewide that has now been replaced with ESChat on

commercial networks. Currently, this customer is also using the SLA Cloud solution. However, it plans to migrate to its own servers in 2015. It chose the SLA Cloud option because it kept start-up costs down.

During the procurement process it tried out three vendors and then based its purchase decision on the features offered, ease of deployment, and up-front start-up costs. Its comment is that the speed of the system is very good, it is very dependable, cost-effective, and cellular network agnostic. Its final comment is that it would not hesitate to recommend ESChat to others.

Agency Confidential - Federally funded multi-jurisdictional Law Enforcement Agency

This organization has an existing LMR system and started using ESChat sixteen months ago. It is running its LMR system as a standalone system and ESChat as standalone system for a different class of user. It is relying on ESChat's Cloud architecture. The decision to make use of the cloud instead of hosting its own servers was based on differences in cost.

The organization evaluated two different push-to-talk over cellular systems from two different vendors and decided on ESChat. It uses ESChat over a wide range of territory, and when compared to its LMR system, which is state-of-the art, it found that its users preferred ESChat because of the much wider coverage area. Finally, it was asked if it would recommend ESChat to others and its response was yes!

Agency Confidential - Major US Metropolitan Police Department

This customer wanted a secondary, secure line of communications and after investigating and testing multiple vendors chose ESChat. It is pleased with the performance, uses ESChat in conjunction with the SLA Cloud, and would recommend ESChat to others. "Definitely. Reliable, secure and is constantly upgrading and improving. Support Staff is always available and has handled numerous ideas and upgrades."

Agency Confidential - Major U.S. Metropolitan Sheriff's Department

This customer has been using ESChat for about a year for specific people within its organization. It tried two different systems before settling on ESChat and is happy with its performance. It stated it would recommend the service to others and that the, "customer service is excellent and very responsive to any new additions, deletions, or questions we have."

Conclusions

As we completed these surveys and followed up with ESChat users we were impressed with how positive they were in discussing their existing experiences with ESChat and their appreciation of the SLA customer service and support. It is clear that these customers are loyal ESChat users, some for multiple years, and all we talked with had renewed their contract for continued service, truly a testament to SLA and the capabilities of ESChat.