LTE Integration of P25 ISSI for Colorado

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Prepared by:
Signals Analytics, LLC

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Executive Overview

The State of Colorado Governor’s Office of Information Technology (OIT) has been planning for the implementation of a statewide Long Term Evolution (LTE) network that will be part of the National Public Safety Broadband Network (NPSBN). The intent is that, over time, this LTE network will provide significant terrestrial and deployable broadband coverage for all local, tribal, state and federal first responders in Colorado. It is unknown when this vision will be fully realized and therefore the support of existing Land Mobile Radio (LMR) systems will be required for the foreseeable future. Additionally, many individual jurisdictions within the state of Colorado have procured or are upgrading and expanding their LMR capabilities. These significant investments in LMR will be utilized for many years and provide the basis of current wireless mission critical voice communications for the State. These driving factors are the main force with developing a planned approach of how to integrate LMR and LTE networks across the state in a way that is compatible with the NPSBN, technically feasible and cost effective.

The Colorado statewide Digital Trunked Radio System or DTRS is an Association of Public-Safety Officials Project 25 (P25) network that interconnects to other P25 networks via the Inter Sub-System Interface (ISSI). Several options exist and will soon be developed for connecting natively from a LTE network to the ISSI. LTE Networks are inherently IP based and the introduction of mission critical push-to-talk (MCPTT) in LTE Release 13 promises direct connectivity between P25 and LTE. Deploying this MCPTT over LTE interoperability will increase the functionality of the P25 network to LTE devices and potentially reduce congestion on the P25 channels. This whitepaper will walk through the definition of the ISSI interface, ISSI interoperability in the state of Colorado, different implementations of ISSI into LTE and suggested actions to help ensure ISSI and LTE integration. Colorado has the opportunity to set a course of direction to ensure both types networks can work cooperatively for the next generation of Public Safety communications.
Overview of P25 ISSI Interface

The current standard for public safety LMR was created by the APCO Project 25 Program and is known simply as P25. P25 has its own standards process that is managed independently by the Telecommunications Industry Association (TIA) and they have developed over 75 main documents\(^1\) that specify the entire network end-to-end. The TIA TSB-102-B documentation suite covers the methodology of how vendors and users utilize the network. The majority of the documents are centered on the radio frequency (RF) or Common Air Interface (CAI), as this was one the primary reasons for the fragmentation in the LMR market. However, it was quickly noted that interoperability between network interfaces was necessary and creation of a new interface would be required. Specifically the TIA-102.BACA-A\(^2\) document defines how Radio Frequency Subsystems (RFSS) can be connected via an IP interface to allow wireline interoperability. The Inter Sub-System Interface (ISSI) is an IP based connection based on the Session Initiation Protocol\(^3\) (SIP) for call control and media is handled via the Real-time Transport Protocol\(^4\) (RTP). Using IP instead of TDM based technology and open interfaces was a new direction for Public Safety LMR. The use of internationally standardized interfaces allowed for interoperability between different vendors RFSS, which before the ISSI was only possible via baseband voice gateways.

Colorado’s statewide LMR system known as the Digital Trunked Radio System or DTRS\(^5\) utilizes P25 technology for Push-To-Talk (PTT) voice services. The DTRS P25 network can and does connect to other P25 networks via ISSI. The use of ISSI allows disparate P25 systems like Front Range Communications Consortium (FRCC) and City of Westminster to be connected via a standardized SIP based interface. Much like ANSI-41 in Code Division Multiple Access (CDMA) and Global System Mobile (GSM) Mobile Application Part (MAP) interfaces that are used for cellular roaming, the ISSI can also allow non-P25 systems to be interconnected to foreign P25 networks to enable interoperability and that is the primary premise of this whitepaper.

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\(^3\) [https://www.ietf.org/rfc/rfc3261.txt](https://www.ietf.org/rfc/rfc3261.txt)

\(^4\) [https://www.ietf.org/rfc/rfc3550.txt](https://www.ietf.org/rfc/rfc3550.txt)

\(^5\) See [http://www.oit.state.co.us/cto/dtrs](http://www.oit.state.co.us/cto/dtrs) for more information on DTRS
The ISSI supports traditional group or one-to-many voice communications and it also supports direct subscriber unit (SU) voice communications. Some of the basic features that the ISSI provides are the following:

- Group Call Setup/Teardown
- SU Call Setup/Teardown
- PTT Voice services for Group and SU Calls
- Roaming Services
  - Subscriber Management
  - SU Authentication

Functionally the ISSI provides some of the basic call connectivity that most people are used to in modern cellular networks. If network ‘A’ and network ‘B’ are connected via the ISSI, then SUs in network ‘A’ can call SUs in network ‘B’. Regardless if the radios are programmed for different frequencies, as long as the SU ID or group ID is available then PTT voice communications can be established. A similar use case would be a T-Mobile cellphone calling a Sprint cellphone. This is an example of interoperability across networks.

ISSI provides similar capability for P25 roaming as seen in a cellular roaming scenario where an AT&T cellphone is physically in a Telefonica network and can make/receive calls. If network ‘A’ SUs can support the same channels, frequencies, numbering plan and talk groups of network “B”, then roaming can be accomplished. Network ‘B’ SUs will be able to authenticate and make calls while in network ‘A’ coverage. Capabilities like this are crucial for mutual aid situations on bordering jurisdictions where coordinated efforts are required by multiple agencies.

However, it should be noted that when the P25 ISSI was created, LTE was not even deployed or available as a standard and thus it was never envisioned as an interface into P25 networks. The ISSI interface was initially meant and still defined as an interface between two P25 RFSSs – not an RFSS and LTE IMS core or MCPTT server. Due to the flexibility of LTE application servers and IMS core network infrastructure, the infrastructure can emulate the signaling and media of a P25 RFSS essentially “looking” like a P25 RFSS.

Overview of State and Front Range Radio Networks

Starting in 2001 the State and it again in 2008 OIT began upgrading their LMR network to P25 and establishing the DTRS across the State. The 220 radio sites and five Zone Controllers provide service for over 1,000 state, local, county, federal and tribal agencies with 82,000+ subscriber radios. In addition to the DTRS P25 network, several other P25 networks reside with individual agencies operating throughout the State. Operational needs, funding and technical challenges have prevented interconnection of all these networks. For integration into a LTE MCPTT system there will be a desire to connect through a common or central router by which all these LMR networks are connected to. Minimizing connection points and IP hops will help ensure that the SIP and RTP packets between

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6 [http://www.oit.state.co.us/cto/dtrs](http://www.oit.state.co.us/cto/dtrs)
networks can be delivered with minimum latency and appropriate security. Within the North Central Region (NCR), which includes Denver and its 9 surrounding counties, the various P25 networks that have been working to interconnect their ISSI and create common channel naming conventions for cross network use and roaming. The Public Safety Communications Subcommittee (PSCS) that manages this process has also been working to define EMS talk groups and EOC talk groups. The proposed common hub approach they are deploying envisions the following entities to be part of the network their ISSI sharing agreement:

- Front Range Communications Consortium (FRCC) – Intergovernmental Agreement between Adcom911 and Weld County
- Denver International Airport (DIA)
- Federal Bureau of Investigation (FBI)
- City of Westminster, CO
- City of Aurora, CO
- Metropolitan Area Radio Cooperative (MARC) – Cooperative between cities of Denver, Lakewood & Arvada
- Colorado State Patrol (CSP) - future

Each one of these P25 networks has ISSI capability that is provided by vendors such as Motorola Solutions, Cassidian (Airbus Defense) and Harris Corporation. These vendors and jurisdictions have been working collaboratively on ISSI interoperability. Even though the ISSI is standardized, the implementation of the ISSI is left up to each vendor, which requires significant integration effort to ensure interoperability. Harris has taken a central role in implementing interoperability for the region with ISSI connections to Motorola Solutions and EADS systems located in the MARC, DTRS and between the Westminster network and FRCC. Additionally, the DTRS system has an ISSI connection to FRCC and DTRS. With the ISSI, users on the DTRS can now communicate to the Westminster users going through the FRCC connection. Although, this is not an ideal or least cost route, it provides a means for establishing calls across multiple networks.
One of the issues the PSCS is dealing with is the aspect of interoperability versus encryption. Due to the multiplicity of vendors, each network has established different modes of encryption; some vendors use AES256 and other use 3DES. Encryption options for P25 networks require significant licensing costs and the different encryption techniques are not compatible with each other. In theory encryption keys could easily be shared across networks, as there is no common P25 key management function between all the networks.

Within the state, the NCR is one of the only consortia working on interconnecting ISSI and creating this ability for bordering regions to interconnect. The necessity for connection to other P25 and non-P25 systems in other parts of the state are not deemed as operationally necessary at this point. Many jurisdictions that are geographically separated do not operationally interact with each other. The amount of resources necessary to plan, design, implement, manage and maintain ISSI interconnects to non-collaborating jurisdictions is something that would be nearly impossible to fund. However, interoperability between surrounding states such as Utah and Wyoming into the Colorado DTRS and border counties/cities is crucial for mutual aid operations.

Options for LTE Interoperability

The integration of P25 PTT voice services into LTE networks can be accomplished in two general ways. The first option is to use an Over-The-Top (OTT) service and the second option is to implement 3GPP Mission Critical PTT (MCPTT). We will evaluate the benefits and challenges of each implementation for Colorado.
OTT Applications

Utilizing OTT applications is something that can be accomplished today with a vast array of options. On Google Play there are over 150 applications available for download that purport to offer PTT functionality, two years ago there were only 16 apps. These apps though can be split into two major categories, the first of those that are enterprise grade and second tier of apps that are for recreational use. For the focus of this paper we will consider applications that are considered enterprise grade. A sample of some of the applications that fit into this category would be BeOn, Zello, Voxer Walkie Talkie, BroadNet, ClearSA PTT, MotoTalk and Wave Mobile Communications.

These applications either work with an enterprise grade server deployed in the public safety network or a cloud based server. Using a server located within your own LTE network offers control over features, additional security and easier integration into a P25 network. Cloud based solutions can be implemented immediately, are very cost effective and scale from single user to massive enterprise grade with relative ease. Nearly all OTT PTT applications have the ability to work on multiple broadband access technologies such as Wi-Fi, LTE and even 3G data. Several of the apps also have a desktop application so PC users can utilize PTT and chat with mobile device users. This added functionality across multiple access technologies and networks can be very attractive by allowing multiple authorized users access to the P25 network via the ISSI connection. Additionally, some of the feature rich functionality offered in OTT apps is not necessarily available in MCPTT. These options include:

- Chat or text integration
- File transfer
- Nearly unlimited virtual talk group creation
- Geo-fenced talk group creation
- Geo-location tracking
- Push to Video integration
- Presence indicators (see who’s in service or online)
- PTT to PC, smartphone, tablet, IP Phone and LMR
- Advanced security at the application layer

Some smartphone vendors such as Samsung and Kyocera have worked to integrate their physical PTT button to the application soft button for true seamless interoperability. The cost to implement and scale up users on OTT systems makes their use very attractive for government users. OTT systems are in use by many government agencies such as the US Army and NCR users. The two major vendors of LMR equipment into Colorado are Harris and Motorola.

- Specific to Harris is the BeOn system, which is a PTT application server platform and phone application software. The BeOn system supports geographic redundancy and has GIS capabilities to show users on a near-real time map and visually select them to talk. It fully integrates with the Harris ISSI solution and supports other vendor ISSI networks with advanced features like embedded AMBE vocoders and AES encryption.

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7 No recommendations are to be inferred with any of these applications. It is merely a representation of some of the available choices.
8 http://blog.zello.com/?p=625
9 Harris BeOn is being evaluated by multiple agencies in the NCR
• Motorola Solutions utilizes similar application server platform and phone application software called Wave Mobile Communications (NOTE: this is the former TwistedPair solution). The Wave server and application have full interoperability and integration with Motorola Astro 25 networks. Advanced features for floor control and end-to-end encryption are supported within an Astro 25 network only. Basic features for voice interoperability can be supported through a separate ISSI gateway.

Since these systems support P25 capabilities in Android and Apple based phones, they use the P25 IMBE/AMBE codec. This allows of the concept of end-to-end functionality with encryption. However, this functionality does not scale well economically as the AMBE/IMBE codec is a licensed piece of software. In most cases this makes the app cost over $300 per device – which could be more than the cost of a low-tier smartphone. The cost structure is essentially linear with very little discount for the volumes that Colorado would need and this makes enabling its use for all smartphone users potentially cost prohibitive. Additionally, the AMBE/IMBE codec is not native to LTE devices and will run on the application processor of the device. This implementation is not an optimized configuration and typically leads to higher battery drain and less talk time on the device when compared to a native vocoder running on a DSP chip. App compatibility testing would be necessary to ensure all LTE devices perform nominally with the application.

Another solution to help reduce individual device licensing costs is to utilize a more centralized approach in the network called transcoding. Transcoding has been used for decades in cellular networks and video formatting with great success. The process involves performing a digital-to-digital format conversion to something the target network or device can interpret. Systems such as the Cisco Instant Connect UMS server support on-demand transcoding of P25 AMBE/IMBE vocoders to common formats such as G.711. Open source or license free codecs such as AMR\(^{10}\) and G.711 are very popular and offer excellent voice quality. By transcoding centrally, license costs can be managed across the network more effectively than per device. Transcoding can incur some loss and delay but packets must be decrypted before being transcoded. If end-to-end encryption is necessary the transcoded packets need to be re-encrypted before being delivered to the end device. It is essential that the function needs to reside in a secure network to ensure end-to-end security.

The other aspect to consider with OTT PTT is that once a vendor is selected for the application, you are locked into that ecosystem. For instance a Zello PTT system cannot directly communicate to a Voxer PTT system. As stated above you can transcode or use a voice gateway but you lose all the key functionality and have only a voice path. Foreign device authentication and interoperability typically breaks under this model or becomes a large scale management problem. For mutual aid users across state borders or from the NPSBN may be using another app or MCPTT that is different from the state and this would create interoperability issues. The other very important aspect is that OTT applications are not directly integrated into the LTE UE, Radio Access Network (RAN) or Evolved Packet Core (EPC). The use of features to enable quality of service and priority (e.g. QCI settings) would need to be manually implemented in the network – which is theoretically possible but would require considerable effort to implement and maintain. Advanced features in VoLTE and MCPTT to enhance cell edge performance may also not be available for OTT applications potentially causing performance issues.

\(^{10}\) AMR is used in the GSM family of cell phone devices which number in the multiple of billions globally
It should be noted that OTT apps have been very adept to implementing advanced features like immediate peril and man down button functionality. Their ability to integrate ISSI, implement changes and adapt dynamically to the market demands makes their use very attractive.
MCPTT

MCPTT\(^{11}\) is currently being developed in 3GPP SA6 for Release 13. The study on Application Architecture & Architecture Enhancements to the EPS and IMS was completed in Sept 2015. Completing the functional architecture and information flows for the 3GPP Release 13 March 2016 freeze date will allow vendors to start developing MCPTT systems. Currently vendors from Ericsson\(^{12}\) and Samsung\(^{13}\) are already demoing pre-Release 13 MCPTT that can be upgraded by software to be compliant to R13. At the end of March 2016 Release 13 content was frozen with a majority of the features necessary for MCPTT. Many of the features in P25 will be represented in MCPTT for LTE including:

<table>
<thead>
<tr>
<th>Security</th>
<th>Codecs &amp; Media Handling</th>
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<tbody>
<tr>
<td>Call Control – On/Off Network</td>
<td>Floor Control – On/Off Network</td>
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<tr>
<td>Broadcast Control – On/Off Network</td>
<td>Group Management</td>
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<tr>
<td>Identity Management</td>
<td>Configuration Management</td>
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There are several key features that MCPTT can offer which will be difficult for OTT providers to compete with. The first and foremost is that MCPTT is also part of Release 14 and devices that are Release 14 compliant will have undergone significant performance and functional testing. An example of this is the inclusion of Off Network features to support LTE-Direct (LTE-D) or Proximity Services (ProSe). The intent of LTE-D is to provide direct device-to-device communications off network for operational support of public safety users that are out of LTE network coverage. The functionality is similar to operating in P25 simplex or direct mode. Operationally though, the performance of LTE-D devices may vary from P25 subscribers since LTE smartphone power will likely be limited to 23 dBm.

Secondly, in Release 13 was the creation of new Quality of Service Class Identifiers (QCI) to support MCPTT for user control and plane traffic. Notably QCI 65, which is a Guaranteed Bit Rate Bearer and QCI 69 which is intended for MCPTT signaling have been specified to provide guaranteed packet delivery in the shortest possible time for LTE. Developing all of the authentication procedures, call management features and QCI is something that OTT vendors will not be able to take advantage of easily. Utilizing QoS is crucial for MCPTT to ensure guaranteed voice delivery in loaded conditions. The NPSBN may result in shared spectrum with commercial service. During peak times of Public Safety and commercial network use, the ability to differentiate Public Safety MCPTT traffic from commercial traffic will be an operational necessity.

Lastly, the use of enhanced multicast broadcast (eMBMS) allows for efficient group communications. Historically and operationally most Public Safety PTT voice use has been a one-to-many implementation with the use of talk groups. However, LTE operates natively in a uni-cast method of communication, e.g., user-to-user for voice communications. The concept of one-to-many communications was originally envisioned for broadcast TV services on LTE and thus the standard for eMBMS was created. The adoption of eMBMS has been hampered in the US, by most carriers, due to the use cases not justifying the cost of fully implementing it, (i.e. viewing habits have changed to on demand video from Netflix, YouTube…etc.). Current eMBMS implementations require a minimum of 10% of the resource blocks (RB) to utilize it; future releases may allow for dynamic use though. For Band 14 that would

\(^{11}\) http://www.3gpp.org/DynaReport/23179.htm
\(^{12}\) http://www.ericsson.com/news/1898408
\(^{13}\) http://www.whowired.com/407675.htm
mean 5 resource blocks or 900 kHz of spectrum would be need to be dedicated for supporting eMBMS MCPTT. This would allow for instantaneous multi-cast communications over the entire eMBMS coverage area for MCPTT and could be utilized for common mutual aid channels or alerts. OTT applications could potentially take advantage of eMBMS but it will require an additional integration effort when compared to MCPTT. It should be noted that recently Australian carrier Telstra\textsuperscript{14}, has implemented eMBMS on one of its three 20 MHz LTE bands and potentially will be evaluating MCPTT for use on the network to support Australian Government Forces.

![Figure 3: MCPTT On-Network Functional Diagram](http://www.ericsson.com/news/1898408)

The initial intent for MCPTT was to fully use the IMS core functionality but 3GPP has allowed some flexibility here in anticipation of Public Safety. 3GPP has allowed for non-IMS MCPTT application servers to be part of the standard as long as their external interfaces are interoperable with IMS networks, EPS networks and the MCPTT subsystems. For OTT vendors this means that an OTT server that has many of the aforementioned rich features not inherent to MCPTT (e.g. chat capabilities) could provide MCPPT services to an LTE network.

The MCPTT function network includes the IWF-1 interface (see Figure 3) which is the interworking function interface to legacy networks. The inclusion of the IWF-1 means that P25 networks will be able to natively integrate with LTE MCPTT. The P25 ISSI interface would operate as the functional connection

and terminate SIP/RTP traffic at the IWF. The current MCPTT standard does not mandate the use of AMBE/IMBE vocoders but allows for transcoding to the approved AMR-WB codec. P25 SU exclusively use the AMBE/IMBE codec and these are quite expensive to license in LTE devices. Since transcoding will likely be utilized for MCPTT calls to non-LTE devices, the security impacts, latency impacts and scaling for users in the State will need to be evaluated. The IWF-1 interface connects to a media function, which will determine whether to pass the traffic through or transcode the voice packets. MCPTT is also intended to scale to support in excess of 500,000 MCPTT groups and up to 150 simultaneous group calls in a LTE sector. This type of scalability will provide enough growth within the MCPTT system for all users within the State.

15 3GPP TS 23.179 – Appendix C
PSBN and Commercial Integration

A unified solution that encompasses interoperability between P25, LTE and IP networks should be something that the NPSBN accomplishes. With the integration of P25 ISSI voice communications there are multiple considerations that should be accounted for to ensure interoperability and usability when connecting to a LTE network.

1. The Public Safety LTE network that will be deployed in Colorado will be a statewide network regardless of whether it is built by FirstNet or Colorado.
2. Many agencies have existing commercial LTE devices and service contracts which they will continue to utilize.
3. The DTRS and other P25 networks throughout the state will also continue to operate into the foreseeable future to support Public Safety operations.
4. Many PSAPs have upgraded to IP based phone systems (e.g. Cisco and Avaya) as have many government offices.

The technology and testing exists today to provide P25 ISSI connectivity to commercial LTE and Public Safety LTE networks. The ability to integrate the multiple vendors’ ISSI solutions into LTE and other access technologies is being done in the NCR with the Harris BeOn network and smartphones operating on various commercial carriers. Jurisdictions evaluating PTT solutions should avoid proprietary solutions that do not interoperate with P25 and MCPTT. Investing in a PTT solution from a vendor will require thoroughly evaluating a solution that can scale cost effectively, integrate into existing public safety networks and be easily upgraded to MCPTT.

Colorado is also fortunate to have the Adcom911 LTE network as one of only 5 PSBN early builder projects in the entire country. The network is currently LTE only and it does not have MCPTT or VoLTE deployed, so there are no native voice services available; only VoIP services like Skype or OTT PTT applications can be used. It is unknown if the current General Dynamics EPC can support MCPTT and they do not have an IMS core deployed locally. Additionally, the PCRF has not been enabled to deploy QCI differentiation for different bearers. If these technical issues can be addressed by the vendor then the Adcom911 network could be used as a testbed for OTT and MCPTT systems. Most of this integration could take place without IMS, even for pre-Release 13 MCPTT and simple changes to the PCRF. The application servers could reside in vendor locations pending IP connectivity. With access to FRCC and DTRS ISSI, the system could be used to test multiple interoperability scenarios and prove out system configurations.

OTT PTT integration into a commercial carrier is as simple as downloading the application on multiple phones and having traffic go over the internet. However, for integration of the ISSI, the ISSI gateway needs to be addressable from the internet or have a routable IP address. Any OTT application that is being considered should have direct support for ISSI. If a particular app does not support ISSI interoperability; it should be disqualified from consideration. Additionally, any OTT PTT app should be software upgradeable to MCPTT. Strong consideration should be given to evaluating pre-Release 13 MCPTT systems from the various LTE infrastructure vendors that are currently offering this feature. In the event of integration into an LTE network, the P25 system it is interconnecting to should act as the “home RFSS”; the LTE network should look like the “serving RFSS”.
Lastly, developing a Statewide ISSI hub or clearing house would be ideal to ensure interoperability between all P25 networks. With the appropriate amount of IP redundancy, this would create a single entry point for commercial and Public Safety LTE networks to interface with. It may take a significant amount of time to implement this but systems similar to NCR’s proposal are proposing are a good start to begin integration.

Figure 4: Proposed Logical ISSI Gateway & MCPTT Diagram
Suggested State Actions

Upon examination of the future growth of LTE for public safety there are several areas where Colorado can provide a framework to ensure successful integration of ISSI and LTE.

Table 1: Issues & Solutions

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<tr>
<th>Issue</th>
<th>Suggested Solution</th>
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<tr>
<td>Limited coordination across multiple agencies P25 networks across the NCR has created the issue of developing a connection hub and governance structure for roaming.</td>
<td>The PSCS effort has spearheaded this effort for the NCR. Supporting this group with the appropriate resources and expanding the scope to include the entire state and bordering States (e.g. Wyoming, Kansas, Utah) would help lead to developing a common ISSI interconnection scheme.</td>
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<td>Currently there is limited effort to interconnect all the P25 networks within the State as there is no operational need to do this for geographically separate areas. For a statewide or nationwide LTE network a logically central connection (router) should be created as an ISSI clearing house to allow connection across all agencies. Definition of authorized users and sharing of encryption keys could be within scope.</td>
<td>The fewer interconnection points that the PSBN has to ISSI the easier it will be to manage overall and it will increase network performance by having less router hops to negotiate. Hosting and managing an ISSI gateway(s) with this scale takes significant resources. LTE is an all IP network and all interconnections will need to be IP based, no TDM connections would be allowed. Leveraging existing systems in the NCR/FRCC would be logical step towards designing a central connection hub.</td>
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<td>Common lists of services, talk/call group naming conventions, numbering plans and allowed user equipment will be necessary for implementing virtual talk groups in a MCPTT LTE network.</td>
<td>The coordination effort across all ISSI channels and non-ISSI channels needs to take place to integrate into MCPTT. The aforementioned group could help manage this effort locally throughout the state and create a common service level agreement.</td>
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<td>SIP and RTP (the protocols used in ISSI) do not traverse across firewalls and multiple private routers without significant design engineering. Nearly all jurisdictions are on their own private and public IP addressing schemes, which will make implementing ISSI LTE integration very difficult to achieve.</td>
<td>Routable IP addresses should be used for all ISSI subscribers and LTE MCPTT subscribers. This may not be practical with existing implementations. The newly formed task group should investigate dual stack (IPv4/IPv6) usability in the network. IPv6 allocations and coordination should be considered for all ISSI networks across the State.</td>
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<td>Several trials are going on in various jurisdictions with OTT PTT systems. MCPTT will not be fully commercially available until 2017 in international markets and likely in the 2018-2019 timeframe for FirstNet. How can Colorado ensure ISSI interoperability, future capabilities and cost targets can be achieved if multiple OTT systems are deployed?</td>
<td>Any OTT PTT system that is being considered for procurement should be software upgradeable to MCPTT, support ISSI natively and offer multiple codecs. A fully resourced and functional testbed could be created in conjunction with the Adcom LTE network, NCR ISSI network and commercial carriers. The goal would be to evaluate available OTT and MCPTT solutions and integrate them into the network, and help create design criteria for a statewide implementation.</td>
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<td>Cost considerations related to ISSI sustainability, e.g., ISSI licenses per port and device are costly to maintain per system. An ISSI hub may be cost prohibitive to maintain.</td>
<td>The current FirstNet RFP requires Public Safety Enterprise Networks (PSEN) to be compliant to FirstNet interfaces. It is unknown what the costs to support and maintain these interfaces are and who would bear the ongoing cost of ISSI interoperability. Further investigation is required on this once an Offeror has been selected. The technical team can also investigate using MC-PTT as the interoperability solution between jurisdictions as opposed to an ISSI hub, or look at non-ISSI solutions for MC-PTT integration.</td>
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