



The Need For A Broadband Interoperability Platform

From Catalyst Communications Technologies,
Inc.

**MANAGING COMMUNICATIONS IN A WORLD WITH MULTIPLE PUSH
TO TALK OVER CELLULAR ALTERNATIVES**

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Introduction

FirstNet® and Early Expectations

FirstNet® built with AT&T was awarded to AT&T in 2017 and at the time, the concept was for a single nationwide network for public safety users, including dedicated LTE frequencies and bandwidth and devices and applications that were seamless across all users. Other carriers and vendors, however, also saw this application opportunity and developed their own LTE based solutions for Push to Talk over Cellular services that were either standards based (i.e., 3GPP compliant mission-critical push to talk (MCPTT)) or proprietary mission-critical communications. And even within the current FirstNet® Applications Catalog, environment, users can opt into proprietary mission-critical push to talk solutions such as Motorola’s Kodiak offering.

The Department of Homeland Security Science and Technology Directorate was mandated by Congress to evaluate and assess new technology in real-world environments to achieve interoperable emergency communications capabilities, understand the strengths and weaknesses of the public safety communications systems in use, evaluate and validating advanced technology concepts, and facilitate the development and deployment of interoperable emergency communication capabilities. DHS S&T has funded research to solve complex communications challenges and solicited proposals for research on how these disparate push to talk solutions might be interoperable with each other. In 2020, Four companies, including Catalyst Communications Technologies, were awarded Phase I Small Business Innovative Research (SBIR) contracts to investigate solutions to this problem. Catalyst has been selected to pursue a Phase II SBIR contract to research and prototype the solution we described in our Phase 1 feasibility study. This is a technical challenge that requires innovation on our part, as the systems include both standards-compliant and proprietary alternatives as described above. This paper describes the evolution of this market need for a Broadband Interoperability Platform (BIOP) and overview of Catalyst’s proposed solution to the problem.

While 3GPP published a standard definition for mission-critical push to talk in their Release 13 document ¹, this standards-based solution was not the first push to talk over broadband solution introduced into the marketplace. Among many early products in the marketplace, Kodiak, later acquired by Motorola, developed a push to talk over broadband solution that AT&T calls Enhanced Push To Talk and that was also adopted by Verizon and others. ESChat and other suppliers introduced proprietary push to talk over broadband solutions that were carrier agnostic and as a result, have achieved some market traction with the

¹ <https://www.3gpp.org/news-events/3gpp-news/mc-services>



first responder community. Also, while AT&T and Verizon were both using the Kodiak solution, users are unable to conduct cross carrier communications.

Adding another level of complexity is that some carriers have indicated that they will offer multiple standards-based mission-critical push to talk from different vendors such as Samsung, Motorola, Ericsson, etc. These systems are also not necessarily compatible with each other, and they may or not be interoperable or work together on different carriers.

As new push to talk broadband solutions were adopted by the first responder community, the challenges become particularly acute during mutual aid events where multiple organizations that need interoperable communications may not be using the same technology and may therefore be constrained in their ability to communicate. DHS S&T recognized this gap and leveraged the DHS SBIR Program to seek solutions for a system that would provide for interoperability amongst these disparate systems. Also, notwithstanding their strong preference for standards-based solutions, DHS S&T recognized that proprietary solutions have gained market traction, and therefore any solution needed to accommodate both standards compliant mission-critical push to talk and proprietary push to talk solutions deployed in the marketplace with an existing consumer base.

Catalyst's Advantages for solving Broadband Push to Talk Interoperability

Catalyst has significant advantages that were already evident before DHS SBIR granted the award. In 2018, DHS S&T identified another challenge to FirstNet™ adoption, which was the lack of communications capability between existing legacy land mobile radio systems used by first responders and the new LTE based systems proposed by FirstNet® and, as we have seen, others. Catalyst was one of two companies who were Phase 1 SBIR award winners and was the sole company awarded a Phase II SBIR contract on this topic to develop that solution, currently our IntelliLink™ Interworking product line being deployed in the marketplace today. Catalyst also won a Phase III award, which is non-SBIR funding, from PSCR, the Public Safety Communications Research division of NIST – the National Institute of Standards and Technology. This funding was used to commercialize LMR to LTE interworking communications.

Relevance of LMR LTE interworking to broadband interoperability is strong. Having already developed interfaces to the 3GPP standards compliant mission-critical push to talk technology deployed on various carrier networks, including FirstNet® built with AT&T and Southern Link CriticalLinc, we were in a strong position to offer a solution for a broadband interoperability platform.

Architecture Choices for a Broadband Interoperability Platform

In the United States, broadband interoperability for mission-critical push to talk, whether standards compliant or proprietary, mostly requires solutions that provide interoperability amongst industry suppliers. One solution among many is provided by FirstNet[®] built by AT&T. Here, two incompatible solutions are currently available through the FirstNet[®] service and Applications Store. One, FirstNet PTT is 3GPP standards compliant Mission-Critical Push To Talk, deployed on cellular LTE services using Samsung technology. The second is FirstNet Rapid Response provisioned using Motorola Kodiak technology. AT&T has indicated that they will maintain having two vendors for the MCX servers and related products within FirstNet[®], (and they are required by the federal legislation that FirstNet[®] use a standards compliant solution). Providing interoperability between these systems will be an ongoing requirement. Outside of the FirstNet ecosystem, AT&T offers a third PTT service known as EPTT to its business and enterprise customers.

Another supplier of push to talk over broadband solutions is Verizon. As with AT&T, Verizon offers both standards compliant Mission-Critical Push to Talk provisioned through cellular infrastructure supplied to them by Ericsson, and also Enhanced Push To Talk provided by Motorola Kodiak. The systems are not interoperable with any of the FirstNet[™] solutions, although communications between Verizon Motorola Kodiak and AT&T Motorola Kodiak may not be a technical challenge.

Yet another carrier with strong regional presence is Southern Linc. This carrier operates primarily in the Southeast United States with a network that provides Mission-Critical Push To Talk from the Ericsson LTE platform. Southern Linc has roaming agreements with various other carriers and its Critical Linc application can run over the top on those networks and interoperate with Critical Linc users on the Southern Linc network. Another provider is ES Chat, a vendor with a proprietary push to talk over broadband application that runs "over-the-top" – that is, on the general LTE network and can provide communications between ES Chat users on, for example, the AT&T network and ES Chat users on the Verizon network. ES Chat has gained traction in the public safety marketplace, and therefore any solution attempting to provide interoperable communications for first responders must accommodate ES Chat in addition to the standards compliant MCPTT solutions provided by FirstNet[®], Verizon, and Southern Linc. Over time, it's possible that additional proprietary and 3GPP standards compliant solutions will become attractive to the first responder community, and some provision for incorporating new push to talk over broadband solution providers must also be accommodated in any broadband interoperability solution.

Technical alternatives for a broadband interoperability platform

In considering solutions for a broadband interoperability platform, Catalyst identified four alternatives that might provide a technological solution to the problem.

Radio Over IP (RoIP)

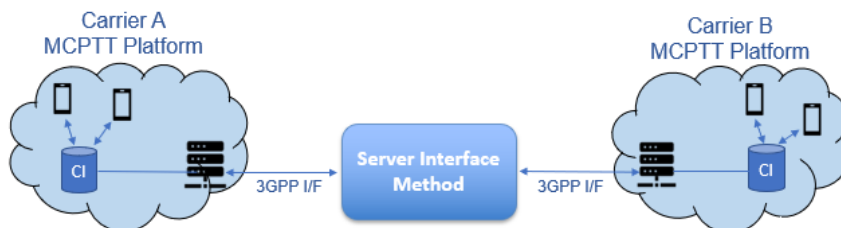
A simple, but ultimately unsatisfactory, solution is to use technology commonly referred to as Radio over IP. This technology is currently deployed and is used in LMR LTE interworking. These systems retrieve analog audio from LTE communications interfaces and passes along the audio to an analog port of a donor land mobile radio. This model can be adapted so that it retrieves audio from one broadband push to talk solution provider, decrypts it, converts it to analog, digitizes it, re-encrypts it, and passes that audio on to another broadband push to talk solution.



A downside of this approach is that mission-critical communications require more than just audio. Call meta-data, including unit ID, emergency, location, and other data points are useful for first responders and also to the dispatchers that are managing communications and responsible for setting up patches between different groups, whether they be LTE groups, LMR groups, or a combination.

Server Side Interfaces

A second technology alternative is to create a communications link between the server-side infrastructure of each broadband push to talk solution.



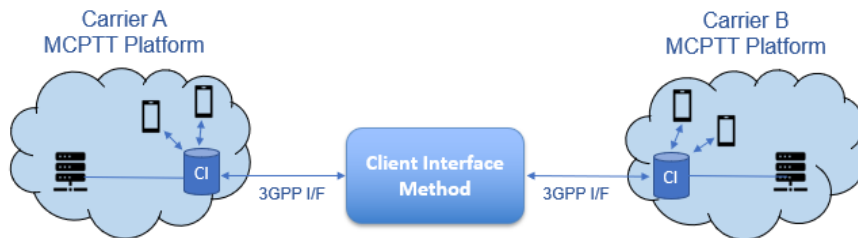
A strength of the solution is that, in addition to passing audio between the various platforms, communications can include the meta-data described in the above paragraph.

The downside to this solution is that it requires a deep integration into the carrier infrastructure, and this is going to be an especially difficult challenge to overcome. It's not clear that the carriers will even allow a direct server side interface, especially if it is to a

competitors' broadband push to talk solution. All kinds of service and maintenance responsibilities arise when connecting broadband push to talk carriers in this way, likely leaving the customer in the middle when each carrier is pointing to the other when trying to resolve communications problems.

Client Side Interfaces

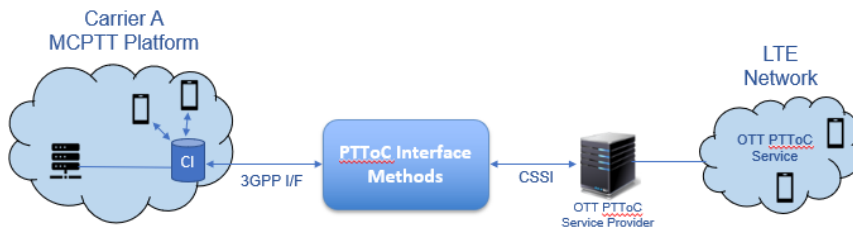
A third solution is to use the 3GPP Standard client interface to the LTE network. In this architecture, the carrier infrastructure sees the broadband interoperability solution as just another LTE subscriber device or better yet, a Dispatch Console.



The strong advantage to this solution is that, since the interface is not directly connected to the server infrastructure, the solution can be deployed without the complex configuration and maintenance with carrier equipment. In addition, it provides most of the capabilities for meta data that are expected by Public Safety communications. Catalyst first deployed the client interface as part of our solution for LMR LTE interworking.

Non Carrier Push to Talk over Broadband Suppliers

A Fourth consideration is how to incorporate non-carrier interface options, including ESChat. For this, Catalyst's solution is to leverage the industry standard P25 CSSI interface. With this architecture, communications between an ES Chat or other vendor's subscriber unit can communicate with a standards compliant or proprietary carrier based solution.

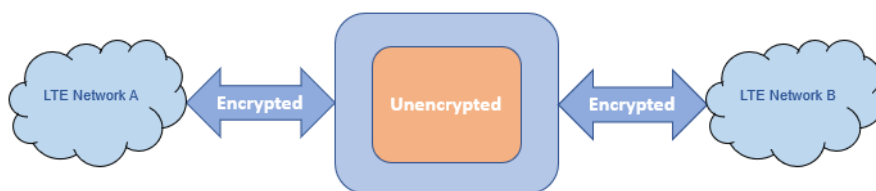


Catalyst Research Summary

With this information as background, a summary of the Phase I Research Report can be described. Catalyst described the baseline push to talk over broadband feature set that would be required by mission-critical communications for a broadband interoperability

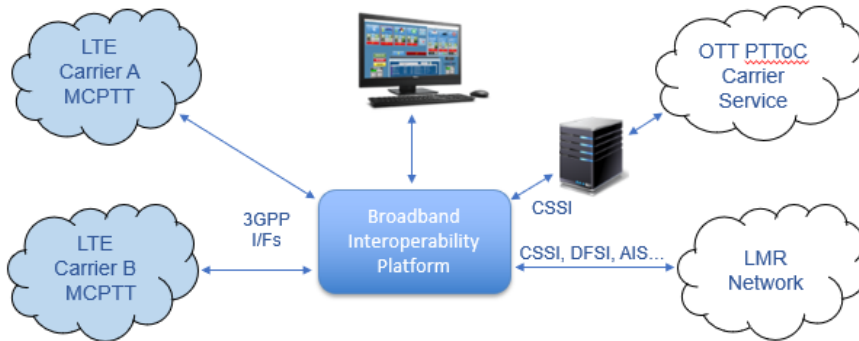
platform, using reports from National Public Safety Telecommunications Council as our guide. In addition to audio, group calls, individual calls, an initial set of meta data are needed by the industry and accommodated by the Catalyst solution. For this meta data, while the industry has not created a standard for which - and how – these messages might be passed from network to network, much of this information can be collected from each broadband push to talk provider and presented to the dispatcher as part of initial deployments of the technology. Our research also uncovered an initial summary of advanced interoperability extensions, including text messaging, emergency and emergency alerting, call override, call priority and preemption, naming conventions, and broadband specific interoperability features. On this last item, we identified the different audio vocoders that might be used by these various networks and provided suggestions as to how these codec issues might get resolved.

A further complication, identified but not resolved by the feasibility study, is the need for end to end encryption between the broadband push to talk platforms. Combined with the different codecs used by the various platforms, this is a very significant technological challenge. Future research, development, and standards body work to define precisely how end-to-end encryption might occur will be required. One solution that can be offered in the short term is to decode and transcode each networks' communications at the device managing broadband interoperability. While not end-to-end encryption, presumably the device managing broadband interoperability will be located in a secure environment, limiting access to unencrypted communications. Using the same key in every end user device is not necessarily more secure than allowing each agency to manage its own keys. In Phase II Catalyst will extend our Phase I research to address multiple aspects of security and explore how modern tools can be leveraged.



A Homogenized, Integrated Approach

From this discussion, an integrated network solution providing communications between various LTE smart phone devices running mission-critical push to talk, or proprietary push to talk, legacy land mobile radio subscriber devices, and a dispatch system, can be considered.



Conclusion

This paper summarizes the Need a Broadband Interoperability Platform. We describe how technological challenges can be overcome to offer such a solution to the mission-critical communications marketplace. We described network architecture alternatives and a rationale for using the 3GPP LTE client interface for carrier connectivity, and the P25 interface for proprietary over the top (and new emerging technology) products.

What will be essential for broadband interoperability to become useable by public is buy in and support from the industry; end users, carriers, network planners, administrators, grant-making agencies, etc. While someday we may move to a single network solution, the reality is that for many years multiple broadband push to talk solutions will exist and first responders will need interoperable communications between them.

Catalyst is a leader in mission-critical communications and is prepared to discuss these concepts in more detail with you and assist as you develop strategies for integrating new LTE based communications capabilities into your first responder operations, whether standards-based, proprietary, and/or integrating legacy land mobile radio. Call us today to begin a dialogue.