IntelliLink™ Interworking Services

From Catalyst Communications Technologies, Inc.

TOOLS TO MIGRATE GRACEFULLY TO FIRSTNET™

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WWW.CATCOMTEC.COM

FirstNet™ promises improved capabilities for First Responders, offering the larger footprint and increased data carrying capacity of LTE, which greatly exceeds that of current LMR systems. The migration from LMR to LTE will be gradual, however, and Push-to-Talk voice communications between the two different systems is going to be required for the foreseeable future. This concept – called "interworking' – will require new technology to enable LMR and LTE to communicate with each other.

This paper describes a research effort sponsored by the Department of Homeland Security (DHS) Science and Technology Directorate (S&T), the results of that research, and a path forward to create a solution that will help users migrate their current land mobile radio systems to FirstNet™.

PREAMBLE AND FOUNDATION FOR THIS PAPER

Interoperability between different radio systems and different radio frequencies was a problem long before the September 11, 2001 attacks on the United States. But that catalyst galvanized efforts to create radio communications interoperability. While great progress has been made, interoperability between systems that matches the capabilities of each individual system has remained elusive.

In 2012, the US Congress created The First Responder Network Authority (FirstNet™) as an independent authority within the National Telecommunications and Information Administration. The purpose of FirstNet™ is to establish, operate, and maintain an interoperable public safety broadband network. To fulfill these objectives, Congress allotted seven billion dollars and 20 MHz of valuable radio spectrum to build the network.

While the early deliverables of FirstNet™ were focused on data applications, it quickly became apparent that a primary user application requirement was for voice communications. With that realization, it was evident that interoperability between existing land mobile radio users and new users on the FirstNet™ LTE network would be required. Some early innovators created LMR LTE interoperability by patching "over the top" push to talk services with land mobile radio systems. However, many organizations, including DHS S&T, recognized that a more comprehensive solution was necessary if FirstNet™ were to be adopted by the first responder community. With one of its missions being advocacy for public safety, a DHS S&T Small Business Innovation Research (SBIR) solicitation was issued to investigate concepts to resolve these challenges. DHS S&T selected, through a competition, two of the companies responding to this solicitation for the Phase 1 research award. Catalyst Communications Technologies, Inc. was one of those companies.

The research award was granted in April 2018 and the results were submitted in November 2018. This paper discusses the goals of the research, results, and a design for an LMR LTE Interworking solution that may be offered to many organizations that wish to migrate to, or interoperate with, FirstNet™.
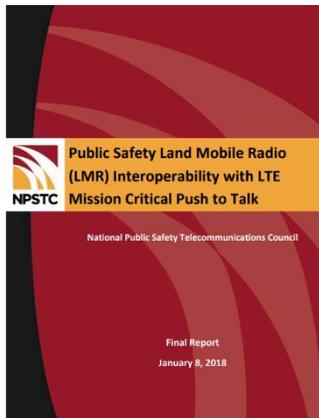
Communications between two different land mobile radio systems is referred to as *interoperability*. When a land mobile radio system is communicating with an LTE based system, the term used is *interworking*.

DHS INTERWORKING PROGRAM GOALS

Of paramount importance to DHS S&T was that any interworking solution take advantage of existing standards to as great an extent as possible. On the LTE side, the 3rd Generation Partnership Project (3GPP) standards are well-respected and represent the logical interface to any outside system requesting access to the LTE infrastructure. On the LMR side, Project 25

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(P25) standards have also been developed and one of these standards, the Inter Sub System Interface (ISSI), was created to enable system to system communications. One question that needed an answer was whether ISSI could be used to communicate with LTE systems, and if so, which of the capabilities needed by first responders were already defined and satisfied within the existing standards.

The communications requirements for first responders was generally well known. In January 2018, NPSTC, the National Public Safety Telecommunications Council, published a report titled *Public Safety Land Mobile Radio (LMR) Interoperability with LTE Mission Critical Push to Talk.* NPSTC is a volunteer federation of public safety organizations whose mission is to improve public safety communications and interoperability through collaborative leadership. NPSTC's members are organizations representing fire, EMS, law enforcement, transportation, and other telecommunications groups.

This document described forty-six requirements that would be necessary for first responders on LTE networks to interwork with first responders on LMR networks. Catalyst analyzed each of these requirements against the backdrop of 3GPP and P25 standards. We also looked at how 3GPP might interwork with other radio systems, including DMR, conventional analog, and certain proprietary radio system protocols.

In North America, the ATIS (Alliance for Telecommunications Industry Solutions) TIA (Telecommunications Industry Association) TR-8.8 (Broadband Data Solutions) Joint Project Committee (JLMRLTE) is defining the LMR interface for Interworking. At the time of the study, the initial indications were that the committee would specify the P25 Inter Sub-System Interface (ISSI). Our study assumes that ISSI will be the preferred interface, but we also examined the following:

3GPP unites Seven telecommunications standard development organizations (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC), known as "Organizational Partners" and provides their members with a stable environment to produce the Reports and Specifications that define 3GPP technologies.

Project 25 (P25 or APCO-25) is a suite of standards for digital mobile radio communications designed for use by public safety organizations in North America.

P25 LMR

➢ LMR P25 Trunked Phase II – ISSI
➢ LMR P25 Trunked Phase I – ISSI
➢ LMR P25 Conventional – DFSI (Digital Fixed Station Interface)

Non-P25 LMR

➢ Analog – FSI (Fixed Station Interface)
➢ DMR – AIS (Application Interface Specification)
➢ TETRA – ISI (Inter-System Interface)

THE RESEARCH PLAN

To perform the research, Catalyst divided the project into a series of tasks to be evaluated. We first looked at the requirements for Standards-Based Network Interfaces, including constraints when supporting interoperability across radio networks using these interfaces. Next, we made an assessment of LMR security risks introduced by LTE and proposed mitigations.

From this review, we then recommended a minimum set of functionality/features/capabilities from the LMR/P25 network perspective needed to support LMR–LMR and LMR-LTE interworking. For this task, we mapped these requirements to the requirements in the NPSTC report. Employing a unique scoring algorithm, we were able to determine metrics for the level of interworking functionality between the leading standard LMR systems with 3GPP LTE Mission Critical Push to Talk (MCPTT).

Your LMR System's Interworking Capabilities Will Differ From Others

Conformance to Core Interworking Requirements
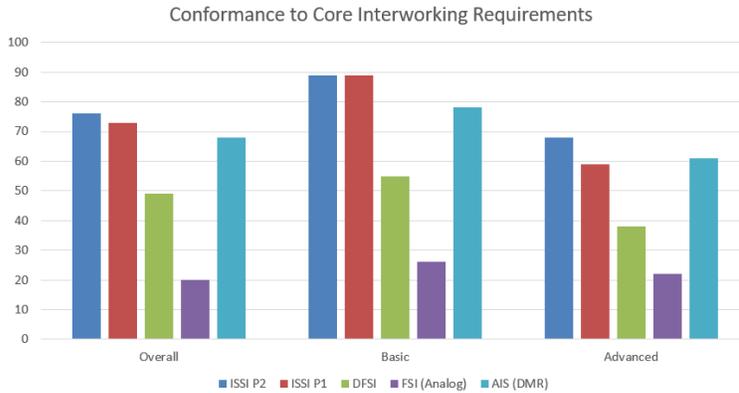
The conformance analysis looked at different levels of functionality including basic interworking and advanced interworking. Basic functionality included Group Calls, Caller ID, Emergency, Late Entry capabilities, codec analysis, Consoles, etc. Advanced functionality adds capabilities such as Private Calls, Location (GPS), Pre-Empt, Group Regrouping for both MCPTT Groups and P25 groups, Text Messaging, etc. From these analyses, we were able to generate solution matrices for the various systems with performance and capability comparisons.

RESEARCH RESULTS

As more information became available during the study period, it became evident that the full Interworking Function (IWF) would not be available to FirstNet™ users for quite some time. To address this issue, Catalyst developed an innovative approach using deployed 3GPP standards without the full IWF. We created a flexible approach to interfacing with various LMR systems including via ISSI.
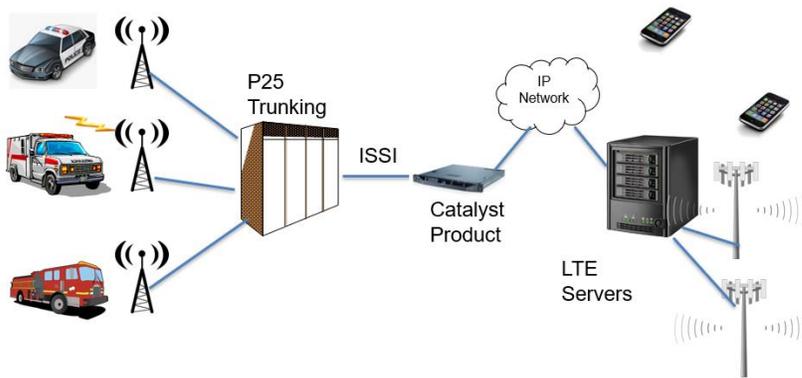
One important result of the research is that few organizations will be able to use the P25 ISSI standard for interworking between their Land Mobile Radio systems and 3GPP LTE systems, including FirstNet™. In 2018 the Project 25 Technology Interest Group (PTIG) reported 2,250 P25 systems deployed in the US. Few of these have ISSI, and the community that can take advantage of FirstNet™ includes more than 17,000 law enforcement agencies, 27,000 fire departments, 21,000 EMS services and many other federal, state and local organizations. Also, the cost of adding ISSI to an existing P25 system can be prohibitive, with costs exceeding 6 figures for many systems.

Recognizing this large number of agencies that cannot use P25 ISSI for interworking between existing LMR systems and new 3GPP LTE / FirstNet™ systems, Catalyst proposed a near term interworking solution that both relies on 3GPP Standards and also leverages non-P25 Standards and non-Standards based radio interface technology, an expertise of Catalyst. The proposed architecture supports P25 Trunked, P25 Conventional, Analog and DMR, NXDN, SmartNet, EDACS, MDC 1200, LTR, and FleetSync. The architecture also supports a Console to manage Interoperability & Communication.

AN INTERWORKING ADAPTER SOLUTION

The architecture of this product supports the substitution of the ISSI interface on the LMR side with Adapter technology specific to the LMR system needing interworking. A variety of standard based (DFSI, DMR) and non-standards based (EDACS, Next Edge, Tone, etc.) interfaces can be provisioned using this solution.
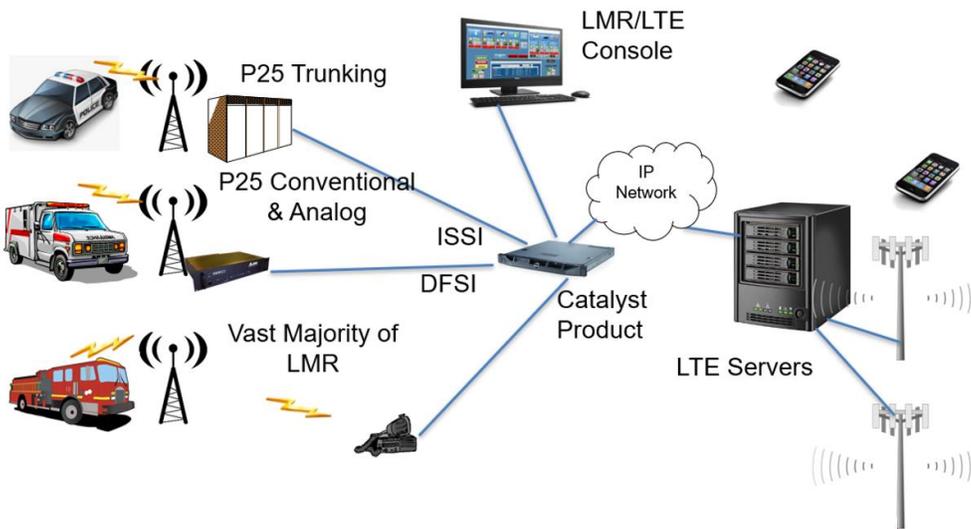
OPERATIONAL INTERWORKING

Interworking in action will need a simple user interface to establish connections between LMR and LTE groups and individuals. As the diagram above illustrates, the Catalyst architecture supports a Dispatch Console, ideal for enhancing interworking functionality. Our initial concept includes a Console that will oversee Basic Console LTE functions and LMR interworking functions. We intend to add this functionality to our existing Console Product for the primary purpose of providing a User Interface for Interworking. During development, the Console interface will allow access and testing of Console MCPTT features stipulated in the Core Requirements. These include monitoring LTE Only talkgroups, monitoring and managing interworked LTE/LMR talkgroups, displaying expanded MCPTT Talker ID and Emergency Status and initiating and receiving Private Calls.

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The Console will also allow dispatchers to perform Operational Interworking.   LTE and MCPTT will provide capabilities that will never be implemented in LMR systems. Some legacy LMR systems will never support Basic Functionality like Unit ID and Emergency. A dispatcher with a console that supports both LMR and LTE can relay information between users on the two systems operationally that could never be passed automatically. This process of allowing a human with the right tool to bridge the LMR and LTE is Operational Interworking.

NEXT STEPS – PHASE II and PHASE III

This paper has summarized the results of a research project awarded to Catalyst Communications Technologies by the Department of Homeland Security Science and Technology Directorate under the federal government's Small Business Innovation Research (SBIR) program. The SBIR program agencies award monetary contracts and/or grants in phases I and II of a three-phase program:

> ➢ Phase I, the startup phase, makes awards for exploration of the technical merit or feasibility of an idea or technology.
> ➢ Phase II awards facilitate expansion of Phase I results. Research and development work advances to a prototype and the developer evaluates the potential for commercialization.
> ➢ Phase III awards are expected to be funded by outside investment or from business activities. No government funding is provided for Phase III.

In April 2019 Catalyst was notified that it had won the Phase II Award and a contract between DHS S&T and Catalyst was signed for this project. We have begun development and our plan is to release five protype products, each building on the capabilities of the prior release, that implement the findings and feature requirements identified in the Phase I research. Our first prototype is expected to be demonstrated at the IWCE convention in April 2020.

In April 2019 Catalyst was notified that it had won the Phase II Award and a contract between DHS S&T and Catalyst was signed for this project.

During the Phase II prototype development, and through the early stages of Phase III commercialization, Catalyst will need the support of early adopters, innovators, channel partners, systems integrators and other members of the public safety / first responder community who are interested in the deployment of new technology that improves mission critical communications and the success of FirstNet™. We encourage any reader of this paper interested in participating in this effort to contact Catalyst.

For potential end users of Interworking solutions, the best results come from a partnership between you and your supplier. Catalyst has depth of experience, so you can have confidence in our expertise. Because Interworking is new and not one-size-fits-all, we can help navigate the possibilities with LMR LTE Interworking to meet the current and unfolding needs of your organization.

For support with your unique Interworking, Dispatch, and Interoperability needs, please contact Catalyst at 434-582-6146 or info@catcomtec.com.