

The Benefits of Project 25



Introduction

When disaster strikes, help rushes in from many directions. It comes from different people, different agencies, and different levels of government. These are the people fighting the fires, chasing down criminals and digging through rubble to save lives. They know the danger of being isolated in an unpredictable situation. They also know what they can accomplish when they work together in one massive, well-coordinated effort rather than dozens of individual undertakings. It is this knowledge that created the Project 25 (P25) radio standard for interoperability. The standard's benefits are unique because the same people who use the radios created P25.

Radio users around the world depend on P25 for their mission critical communications. The P25 Standard is also adopted by many industries such as utilities, airports, transit, petroleum, and chemical companies that rely on mission-critical communications and interoperability with public safety agencies in an emergency.

Project 25 Background

The P25 standard has a twenty-six year history within the public safety community. It was established in October 1989 when APCO¹, NASTD², NCS³, NTIA⁴, and NSA⁵ collaborated in the creation of the APCO-NASTD-Fed Project 25 which is now known as Project 25 or P25. This link to the people on the front lines of emergency response is still a fundamental aspect of the standard. Public safety professionals play a critical role in the standards development process in cooperation with the Telecommunications Industry Association (TIA). These users define and prioritize user requirements for possible P25/TIA standardization. Users also participate in and contribute to technical working groups drafting the standard documents. Project 25 is unique because the people who actually use the radios contribute directly to the specification. This ensures P25 provides the benefits they need. Below are some of the key benefits

.

P25: Enabling Interoperability in the US and Around the World

The P25 standard enables interoperability among multiple manufacturers' P25 products designed to the P25 standard. There are a total of 34 P25 equipment manufacturers and service providers in the marketplace offering a large portfolio of Project 25 solutions to choose from. This robust competition within the P25 market space continues to drive Project 25 product and service enhancements and innovation.

In the United States, Project 25 is widely adopted by local, county, tribal, state, and federal agencies. There are currently over 700 Project 25 systems on the air supporting interoperable communications in the United States, Australia, Canada and the UK. There are additional P25 systems operating in over 80 other nations worldwide. The P25 Standard has the support of the US Department of Homeland Security (DHS). The *Office of Emergency Communications Fiscal Year 2015 SAFECOM Guidance on Emergency Communications Grants*⁶ specifies that, “grantees should continue to invest in equipment that is standards-based to enable interoperability between agencies and jurisdictions, regardless of vendor”, and further recommends P25-compliant LMR equipment for mission critical communications. Additionally, the Federal Communications Commission (FCC) defines specific channels within the 700 MHz band allocation as “Narrowband Interoperability Channels” and requires P25 to maintain interoperability⁷.

¹ Association of Public Safety Communications Officials

² National Association of State Technology Directors

³ National Communication System (In 2012 NCS was retired and its functions were transferred to the OEC.)

⁴ National Telecommunications and Information Administration

⁵ National Security Agency

⁶

<http://www.dhs.gov/sites/default/files/publications/FINAL%20FY%202015%20SAFECOM%20Guidance%20V2%20040815%20508C.pdf>

⁷ FCC Rule 90.548(a)(1)

A Public Safety Grade Standard

The Public Safety Community requires a wide variety of interoperable, standards based Communication Services, Configurations, and Capabilities with well-defined performance, interoperability, and testing specifications. This is the essence of the Project 25 suite of standards as it relates to “Public Safety Grade” Communications Systems.

A “Public Safety Grade” Communications Standard first and foremost provides a set of features, capabilities and services required by the diverse group of Public Safety users. The Project 25 User Needs Sub-Committee (UNS) has defined those required features and the Project 25 Suite of Standards supports those features. Manufacturers take the features and specifications defined by the Project 25 Standard and implement them in reliable software, hosted on rugged hardware platforms that are exhaustively tested to ensure systems are reliant and resilient and the Project 25 features and capabilities are available even under severe conditions.

A P25 “Suite of Standards” with Multiple Interfaces for Interoperability

The P25 Common Air Interface (CAI) is the “core” of interoperability and is the most widely deployed P25 interface enabling interoperability between P25 radios and also between P25 radios and P25 infrastructure regardless of manufacturer. Public safety users can now obtain documented proof of interoperability between P25 Phase 1 FDMA (Frequency Division Multiple Access) CAI Trunked Subscribers and P25 Phase 1 FDMA CAI Trunked Infrastructure in manufacturer issued SDoCs (Supplier’s Declarations of Compliance) and STRs (Summary Test Reports) as part of the DHS Compliance Assessment Program. These can be found on the DHS first responder Website⁸.

In addition to the FDMA Common Air Interface, the P25 standard suite also enables interoperability for the TDMA (Time Division Multiple Access) Common Air Interface and wireline interfaces as part of Phase 2 of the project. The TDMA interface provides the capability to support two simultaneous conversations in a 12.5 kHz channel bandwidth, which meets the FCC requirements for 6.25 kHz spectrum efficient equivalence.

Unlike most LMR technical standards, which focus on the over-the-air protocols, Project 25 also includes a complete suite of technical standards for its wired infrastructure. One of the most important wireline interfaces for interoperability is the Inter-RF Subsystem Interface (ISSI), which is used to connect P25 networks together, independent of the manufacturer. This intersystem connection allows users to roam from one network to another network, have encrypted communications across the networks, and permits roamers to talk back to their home system. ISSI gateways have been commercially available for a number of years and several manufacturers have successfully demonstrated this capability. Recently, second generation versions of the ISSI capability have become available which support “automatic” roaming and caller ID.

⁸ <http://www.firstresponder.gov/P25%20CAP%20Resources/Pages/GrantEligibleEquipment.aspx>

Additional wireline interfaces that are part of the P25 suite of standards are the Console Sub-System Interface (CSSI) and the Fixed Station Interface (FSI). The CSSI defines a standard interface between a dispatch Console Subsystem (CSS) and a P25 RF Subsystem (RFSS). This interface provides for interoperability between multiple dispatch console vendors and system or infrastructure manufacturers. It currently supports Trunked P25 systems, and partially supports Conventional P25 system, with enhanced conventional support coming in the future. Support for the CSSI is currently available from several manufacturers as well.

The Fixed Station Interface (FSI) is used for connecting conventional base stations and repeaters to other infrastructure components, such as dispatch Console Subsystems. The FSI supports both an analog connection using 2 and 4-wire circuits, known as the Analog Fixed Station Interface (AFSI), and a digital connection known as the Digital Fixed Station Interface (DFSI). These two modes allow the use of legacy E&M and/or Tone Remote Control (TRC) wireline control equipment, with a moderate level of control, or pure-IP based equipment, with full control. The support for legacy interfaces allows users to retain their large investment of control equipment (consoles, desktop remotes, etc.), while giving them a migration path to full digital control as their budget allows.

The DFSI supports all conventional P25 features, including group and individual calls. The AFSI supports group calls. Both the AFSI and DFSI may be used for analog and digital (P25 CAI) mode air transmissions and also support fixed station control, which includes the ability to change the transceiver's channel, NAC code, repeat enable/disable, and coded/clear transmissions.

The P25 suite of standards also enables interoperability for Data and Secure Services including but not limited to Over-the-Air-Rekeying (OTAR) that provides for key management of encrypted voice and data communications regardless of radio or Key Management Facility (KMF) manufacturer. Today there are multiple P25 Manufacturers offering OTAR and KMF solutions.

Wide-ranging Project 25 Benefits

First responders have various needs. P25 is designed to enable those users to focus on the mission, not the technology itself. Some key benefits include:

Feature Rich Variety of P25 Call Types

A wide variety of P25 call types and features are available to each radio user travelling across the CAI, ISSI, CSI, and DFSI interfaces detailed in the last section. These call features include: group and individual calls, emergency calls, unit IDs, supplemental services (e.g. call alert, radio check, radio monitor, radio disable, status), all with and without encryption. A complete listing of Project 25 Features and capabilities can be found in the P25 capabilities guide link on the [www. Project25.org](http://www.Project25.org) Website homepage.

Geography and Frequency Flexibility

P25 supports a variety of system configurations including direct mode, repeated, single site, multi-site, voting, multicast, and simulcast operation addressing a wide array of unique agency coverage requirements. This flexibility is available for both conventional and trunked applications. This variety of system configurations allows the system developer to choose a

system design that offers the highest performance from a cost effective infrastructure that best matches their specific needs and local environment. For example, P25 offers high-power operation allowing large geographic areas to be covered with fewer sites than other technologies, making P25 technology an economical and efficient choice. Additionally, simulcast operation allows agencies in more urban, crowded environments to reuse scarce frequencies and increase coverage penetration within a given area.

The P25 standard itself is frequency agnostic. P25 equipment is available from numerous suppliers in VHF, UHF, 700, 800, and 900 MHz frequency bands to meet the diverse frequency requirements of agencies around the world. Consult your local regulatory authority or frequency coordinator to determine appropriate frequency bands available in your area. The Project 25 standard enables multiple frequency bands to be supported on one system and today there are P25 radios available that support multiple bands, further enhancing interoperability.

Improved Spectral Efficiency and Ease of Migration

One of the primary benefits of P25 has always been to allow users to gracefully migrate from established 25 kHz channel bandwidth system operation to more spectrally efficient “narrowband” operation in a 12.5 kHz channel bandwidth and even further to a 6.25 kHz channel bandwidth (or equivalent). This is especially important in certain frequency bands where narrowband operation is required by the FCC.

The P25 standard is spectrally efficient as it operates in a 12.5 KHz channel bandwidth for both P25 Phase 1 FDMA and Phase 2 TDMA operations. Additionally the P25 Phase 2 TDMA interface meets the US FCC regulatory requirements for 6.25 kHz spectrum efficiency equivalence due to the fact that it supports two simultaneous conversations in each 12.5 kHz channel.

Project 25 is unique in that both P25 Phase 1 and Phase 2 equipment is compatible with and designed to coexist with existing analog systems. This flexibility allows users to utilize existing bandwidth and frequency allocations as they migrate from one technology era to the next. Additionally, trunking systems utilize the same structure for the control channel for Phase 1 and Phase 2. This allows users to migrate their systems from Phase 1 to Phase 2 gradually on a channel-by-channel basis. This feature even allows dynamic channel allocation where the trunking infrastructure can operate in either Phase 1 or Phase 2 mode for each communication depending on the subscriber unit capabilities participating in a given call. This further helps to maximize channel and infrastructure efficiency.

Flexible Operations Support

P25 meets the wide array of needs of users ranging from local and small areas to wide area configurations. Both Conventional and Trunked operation is available in local and wide area configurations.

- **Conventional Operation:** Conventional Operation meets the needs of agencies for cost-effective, low-density communications systems. Conventional Operation enables users to operate on fixed RF channels without the need for a control channel, yet the P25 standard still provides conventional users with advanced features such as caller ID and digital encryption. Conventional operation also allows for direct user-to-user communications where a repeater may not be available, or off-network operation is desired, such as for fire-ground operation, or traffic

control at an incident scene. Users simply select the appropriate channel in their radios and communicate immediately with no repeater set-up time.

- **Trunked Operation:** Trunked Operation meets the needs of agencies that have a high-density of users by enabling resource efficiencies. Unlike conventional operation in which a radio channel is dedicated to a particular user group for communications, trunking provides users access to a shared collection of radio channels. Trunked Operation provides many advanced features and may be particularly attractive to agencies in communities that want to join together to form shared regional systems.

Security

P25 supports both voice and data digital communications. Project 25 offers both clear and encrypted voice and data communication enabling a wide array of features and functionality. P25 defines numerous features and functions that enhance a user's communication, such as location and OTAR (Over-The-Air-Rekeying).

P25 supports secure communication through the use of Federal Government endorsed 256 bit key AES encryption, key management, and equipment authentication. For added security when communicating sensitive information, agencies should consider encrypting radio traffic.

An Evolving Suite of Standards

P25 continues to expand and evolve. Changes to the Standard occur when new requirements are introduced, existing requirements are modified, and when new technological enhancements and innovations become available. Current work items include...

- **Link Layer Encryption** is in progress. This is the first big new technology upgrade for improved Security for all air interfaces of P25. It protects control channel control messages, and hides group and individual IDs.
- An addendum to the **Key Fill Interface** standard is in progress. This will enable Key Fill Device (KVL) interface to a KMF, an Authentication Facility and another Key Fill Device
- A revision to the **Fixed Station Interface Standard** is in progress. This revision adds additional capabilities the most significant of which is Packet Data to support OTAR and other data features.
- A new standard for a **TDMA Control Channel** is in progress. This standard provides the messages and procedures for operating a 12.5 kHz channel with 2 TDMA slots where either or both may service Control Channel traffic.

Conclusion

Thus, "Public Safety Grade" Project 25 equipment is the foundation of North American Public Safety Communications and the cornerstone of many Public Safety Grade Systems around the world. The non-proprietary, open standard gives purchasers a wide variety of options among many vendors, which helps ensure interoperability while providing competitive pricing. The P25 "user driven" technology standardization approach continues to guide the decision making process for P25 technologists and engineers into the future. The result will be updates and improvements to existing Standards and the development of new P25 Standards that result in capability and performance improvements for Project 25 products and services.