P25 Foundations
System Technology Updates for 2017

Presented by:
PTIG - The Project 25 Technology Interest Group
www.project25.org – Booth 746
Program Participants

Moderator

• **Steve Nichols**, Director, PROJECT 25 TECHNOLOGY INTEREST GROUP (PTIG)

Panelists

• **Dominick Arcuri**, Principal, DVA CONSULTING LLC
• **Jim Holthaus**, Vice President –Project25 Solutions, RELM; Chairman Private Radio Section, TIA
• **Karthik Rangarajan**, Senior Vice President of Strategy and Products, EF JOHNSON
• **Todd Perdieu**, Senior Manager of Radio Products, HARRIS CORPORATION
• **Andy Davis**, Senior Resource Manager, Project 25, MOTOROLA SOLUTIONS, Chairman TIA TR-8
• **Sridhar Kowdley**, Program Manager, DHS S&T First Responders Group, OIC
• **Cheryl Giggetts**, Senior Vice President, AECOMM
• **Chris Lougee**, Principal, 5x9 COMMUNICATIONS
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Take Away Topics To Look For

• What P25 resources are available through PTIG
• P25: A Suite of Standards, the Process, why P25 is user driven
• P25 Interfaces defined with examples of P25 Conventional and Trunking systems configurations.
• A P25 Standards update: recently released documents and future priorities
• P25 Network Interfaces and Interoperability: ISSI, CSSI, FSI
• How P25 LMR and PS LTE can work together
• The Reality of Multiple Vendor Interoperability with P25
• A look at P25 in the Market, Products and Services available
Project 25 Technology Interest Group (PTIG)

What do we do:

• Provide a forum for users and manufacturers
• Manage education and training on Project 25
• Create and distribute Project 25 information
• Support the TIA standards process
• Offer Users access to the standards process without the rigor of TIA membership
• Maintain a “neutral ground” among the competing manufacturers and providers

And...

• Present Classroom Training and Panels such as This Session.
Project 25 Technology Interest Group:
Corporate and Professional Members
Welcome to the Project 25 Technology Interest Group

The Project 25 Technology Interest Group (PTIG) brings you this website to provide information on all topics concerning Project 25.

Please register on the site for access to additional information. If you previously registered prior to June 2010, a new registration is required. This is to assure we have current and accurate information.

Registration is required to maintain a spam free site for you. No fees are required for website registration.

PTIG MEMBERS NOTE: When your individual registration is validated for affiliation to a paid membership or a commercial member company, your registration will provide member access privileges.

Use the dialog box titled “Contact Us” on the home page for any inquiries about registration and membership.

This site is the official home of PTIG and our P25 community. Your suggestions and comments are always welcome. Use the dialog box titled “Contact Us” on the home page to make your suggestions, offer comments, or seek more information.

What is Project 25?
Project 25 (P25) is the standard for the design and manufacture of interoperable digital two-way wireless communications products. Developed in North America.

Why P25?
Project 25 enables successful fulfillment of these factors so critical to public safety operations and use of two-way radio communications in the field.
Project 25 Technology Interest Group (PTIG)


**P25 Frequently Asked Questions**

*Updated in 2016. Written to officer, firefighter (non technologist) level*

**P25 Updated Capability Guide**

*Remains the best tool for managing P25 features and capabilities for system planning and RFP development*

**P25 Standards Update Summary**

*Summary of the latest TIA TR-8 P25 Standards Meetings with user benefits defined*

**P25 Steering Committee Approved List of Standards**

*Updated from the most recent P25 Standards meeting*

**P25 Feature Translator**

*link to NPSTC PAM tool*
PTIG has published a June 2016 update to its list of known P25 Systems in the USA, Australia, Canada, New Zealand, and the UK.

Both P25 systems lists are organized by state, and territory. The Information for each system includes: System name, System user type (Federal, Tribal, Public Safety, Utility, Campus Police etc.), and Frequency band.

**List of P25 Conventional Systems: 1299**

The P25 Conventional systems total is 1299. P25 Conventional systems are identified as digital only or mixed mode analog and digital.

**List of P25 Trunking Systems: 842**

The P25 Trunking system list has grown from 711 systems November 2015 to 842 systems today. P25 Trunking systems are identified as P25 Phase 1 or P25 Phase 2.

The grand total is **2141 Project 25 Systems**
Project 25 Technology Interest Group (PTIG)

New Documents available at www.Project25.org

New White paper: Now is a good time to revisit the use of P25 Technologies on the Fire ground.

During the past few years there have been updates to the P25 standards, improvements to the P25 vocoder and new P25 products incorporating these improvements that deliver improved performance on the fire ground.

P25 System of the Month

Each month a new Project 25 system is featured describing the system, coverage, agencies served, interoperability achieved and other unique details of this application of Project 25 technology.

New White Paper: Technology Benefits of Project 25

This article has been recently updated to include the new wireline interfaces (ISSI, CSSI, FSI) and new operational capabilities recently added to the P25 suite of standards.

The Whitepaper covers the background and history of the P25 Standard, original goals and objectives, a summary overview of the standards and how they translate into benefits for the Public Safety community.
# PROJECT 25 TECHNOLOGY INTEREST GROUP

**Visit PTIG Booth # 746 IWCE 2017**

**OUR MEMBER ORGANIZATIONS AS EXHIBITORS ALSO SAY THANK YOU**

## PROJECT 25 TECHNOLOGY INTEREST GROUP MEMBERS EXHIBITING

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**SUSTAINING MEMBERS**

**FOUNDING MEMBERS**
Project 25 Foundations
P25 Basics, Interfaces, and Terminology

Dominick Arcuri
Principal, DVA Consulting

Presented by:
PTIG - The Project 25 Technology Interest Group
www.project25.org – Booth 746
Project 25 Introduction: Topics

Origins and History of P25
The Goals of P25
The Standards
Interoperability
P25 Meeting its Goals
The Continuing Evolution of P25
1980s LMR Environment
Leading to the Creation Project 25

FCC mandating improvements in VHF/UHF efficiency
Opening of 800 MHz band
FCC announces plans for trunking spectrum
First seen as a new “Community Repeater”; then Public Safety adoption
Many implementations of APCO Project 16, which did not interoperate
Public Safety organizes to support standards
Voice processing and advances in digital technologies and modulation techniques offer new opportunities
The Federal Government joins the movement
Growing emphasis on encryption and data

The Association of Public-Safety Communications Officials (APCO),
The National Association of State Telecommunications Directors (NASTD),
The National Communications System (NCS),
The National Telecommunications and Information Administration (NTIA),
The Department of Defense (DoD),
The National Security Agency (NSA)

Agree to the Creation of;
APCO – NASTD – FED Project 25
(later shortened to Project 25)
P25 Primary Objectives/Technology Goals

- Maximize Spectrum Efficiency
- Facilitate Multi-source Procurement
- Promote Interoperability
- Develop User-Friendly Equipment

- Frequency Independent
- Compatible with Existing Equipment
- Gradual Migration from Existing Systems
- Coverage Equivalent to Existing Analog Coverage
- Integrate both Voice and Data

P25 Primary Objectives/Technology Goals

Maximize Spectrum Efficiency
Facilitate Multi-source Procurement
Promote Interoperability
Develop User-Friendly Equipment
P25 is a suite of over 85 standard documents and Telecommunication Systems Bulletins

The P25 suite of standards defines:

- The services offered by P25
- The system interfaces of P25
Key Project 25 Interfaces

P25 has standardized the Common Air Interface (CAI) and multiple Wireline Interfaces

- Common Air I/F (CAI): Trunking
- RF Sub-System 1
- Fixed Station Interface (FSI)
- Inter Sub-System Interface (ISSI)
- Console Interface
- RF Sub-System 2
- CAI: Conventional
- Key Fill Interface
- Inter KMF Interface
- Packet Data Host Network Interface
- Mobile Data Peripheral Interface
P25 Phase I Common Air Interface (CAI)

Designed to operate with 12.5 kHz channel spacing
Frequency Division Multiple Access (FDMA)
Data Rate: 9.6 kbps
Modulation: 4-level form of FSK (C4FM)
Vocoder: DVSI’s IMBE (7.2 kbps)
Supports conventional, trunking and secure communications
Conventional channel protocol same as trunking traffic channel
P25 CAI Modulation and Vocoder

TRANSMITTERS

C4FM
- BFO
- Frequency Modulator
- CLASS C

CQPSK
- BFO
- Linearizer
- CLASS AE

COMMON RECEIVER

- Constant Envelope
- Spectrum

2800 bits/s error correction
2400 bits/s signaling
4400 bits/s voice
20 ms of speech = 88 bits of information to be transmitted over the radio link

Total 9600 bits/s
P25 Phase 2 CAI

• 12 kb/s air link rate for 2 slot TDMA
• Modulation
  – H-DQPSK for downlink (outbound)
  – H-CPM for uplink (inbound)
• TDMA Voice Channels
• Dual Rate Vocoder
• FDMA Control Channel (Phase 1 CCH base)
  – With TDMA extensions (for migration & compatibility with PH I)
FDMA (PH 1) and TDMA (PH 2) Operation

FDMA Provides 1 User in 12.5 kHz (P25 Ph 1) (FDMA-Frequency Division Multiple Access)

TDMA Provides 2 Users in 12.5 kHz (P25 Ph 2, 2-slot TDMA) (TDMA-Time Division Multiple Access)
P25 Vocoders

Phase 1 uses the full rate IMBE Vocoder from Digital Voice Systems Incorporated (DVSI)

- 7200 b/s with error correction
- 9600 b/s – 7200 b/s = 2400 b/s for control/overhead

Phase 2 TDMA uses the enhanced ½ rate IMBE Vocoder from DVSI

- 3600 b/s with error correction
- 12000 b/s – 7200 b/s (2 x 3600 b/s) = 4800 b/s for control/overhead and slot management (2400 b/s per slot)

Dual Rate Vocoder

- Enhanced ½ rate IMBE + full rate IMBE
- Radios can dynamically support Phase 1 or Phase 2 calls as necessary
Project 25: Interfaces & Services

**AIR INTERFACES**
- P25 FDMA
  - COMMON AIR INTERFACE
  - TRUNKING: Voice/Data
  - CONVENTIONAL: Voice/Data
- P25 TDMA
  - COMMON AIR INTERFACE
  - TRUNKING: Voice

**WIRELINE INTERFACES**
- ISSI/CSSI
  - TRUNKING: Voice/Data/Control
  - CONVENTIONAL: Voice/Control
- FSI
  - Conventional Analog/Digital Voice/Control

**SECURITY INTERFACES**
- INTER-KMF
  - Key Fill

**SECURITY SERVICES**
- ENCRYPTION
  - Voice/Data
- LOCATION
  - TIER 1
    - Conventional
  - TIER 2
    - Trunking/Conventional

**DATA SERVICES**
- authenticates
- - TRUNKING

**DATA INTERFACES**
- Gateway
  - DATA NETWORK INTERFACE
- SUBSCRIBER DATA PERIPHERAL INTERFACE
Barriers to interoperability

Technical barriers

• Lack of Standards
• Different Frequency Bands
• Lack of Common programming templates
  ○ Compatible ID plans, etc.

Operational barriers

• No Common Operating Procedures
• Lack of Planning
How P25 Promotes Interoperability

• Over the air interoperability
  – Radio to Radio of different manufacturers
  – Radios from different manufacturers on a common system within a coverage area (conventional or trunked)
    • Neighboring jurisdictions during a common event or vehicle pursuit
    • Outside agencies responding during a mutual aid event

• Intra and Inter System Interoperability
  – Multiple dispatch facilities utilizing a common infrastructure
  – Neighboring jurisdictions that permit roaming while maintaining home system contact
  – Multiple system interconnected to create a larger system
Over the Air Interoperability via P25

Direct Mode

Trunking

Conventional
Multi-Agency Interoperability via P25

P25 permits multiple agencies to share common infrastructure and each make their own purchasing decisions.
Intersystem Interoperability via P25

The P25 ISSI permits roaming to a neighboring system while maintaining home system contact.
P25 Transition and Migration

P25 manufacturers supports backward compatibility to legacy systems

P25 supports a smooth migration from Phase 1 to Phase 2
P25 Compliance Assessment

Compliance Assessment Program (CAP)

P25 CAP testing ensures that there is a choice

• Multiple vendors subscriber equipment is tested on Multiple vendor Networking equipment

Provides a mechanism for P25 equipment suppliers to formally demonstrate their products' compliance

• Testing a key subset of the P25 Standards
• Performed in CAP recognized labs

CAP results

• After testing SDOCs and STRs are approved by DHS
Project 25: Summary

Designed for public safety by public safety

P25 is a suite of mobile radio standards and bulletins which define interoperable communications for emergency services

Developed in partnership between Public Safety and TIA

- Project 25 formed in 1989
- Initial standards released in 1995
- Original goals have been met, yet
- Ongoing development and evolution of the standards continue with broad industry support
Project 25: The Goals and Additional Benefits

- Migration from Legacy and Ph 1 to Ph 2
- Enabling Interoperability
- Multi-Vendor Sourcing
- Spectral Efficiency
- Public Safety User Driven
- Secure Communications
- Conventional & Trunked Operation
- Coverage Flexibility
- Established
- Voice and Data
- Global Standard with Worldwide Adoption
- Multiple Frequency Bands
- Evolving
Thank You

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Project 25 Foundations
P25 Conventional System Configurations
Interoperability and Best Practices

Jim Holthaus
Vice President – Project 25 Solutions, RELM

Presented by:
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www.project25.org – Booth 746
P25 General Systems Model

P25 Common Air Interface (CAI) Types
1. P25 Conv CAI - Conventional P25 FDMA Common Air Interface
2. P25 Trunked CAI - Trunked P25 FDMA/TDMA Common Air Interface

P25 Wireline Interface Types
1. Eg - Inter RF Sub-System Interface (ISSI)
2. Ec - Console Sub-System Interface (CSSI)
3. Ef - Conventional Fixed Station Interface (FSI)
4. Ed - Data Host Network Interface
5. MDP - Mobile Data Peripheral Interface (MDP)
6. IKI - Inter Key Management Facility Interfaces (IKI)
7. KFD - Key Fill Device Interface
8. Et - Telephone Interconnect
9. En - Network Management

Adopted from TSB-102-B v7
Conventional
Standard Interfaces and Services

Configurations Using the FDMA Common Air Interface
• Voice, Data and Supplementary Services

Configurations Using Wireline Interfaces
• Fixed Station Interface
• Conventional Console Subsystem Interface
Conventional Configurations

Voice, Data and Supplementary Services

**Direct Mode**

- FDMA CAI

Conventional Voice services
- Group Call, Individual Call, All Call, Talking Party ID, etc

Conventional Supplementary Services
- Emergency Alarm, Call Alert, Status/Message, etc

*FDMA CAI data protocol*
- Data Applications may originate in the radio or an external device
- The CAI data packets may carry IPv4 datagrams
- IP Data Bearer service for data applications that use IPv4

**Note:**
For a complete set of **voice and supplementary services** supported by the FDMA CAI for the 3 conventional configurations see section 2 of the PTIG Capabilities Guide.

For a complete set of **CAI data bearer and IP data bearer services** supported by the FDMA CAI for the Direct conventional configuration see sections 3 of the PTIG Capabilities Guide.
RFSS may take on a variety of physical forms, i.e. there may be

- multiple channels at a site or
- multiple sites, or
- channel may be a voting, multicast or simulcast “sub-system” covering multiple physical sites
Conventional Configurations

Voice, Data and Supplementary Services

Repeated with Wireline Dispatch

RFSS B may still repeat
Console may participate in calls
Console may be the source or target of calls
Console equipment may interface to multiple stations
Console equipment and station(s) within the RFSS do not need a standard P25 interface
Encrypted Voice, Data and Supplementary Services

- Encryption service applies to all 3 conventional configurations
- Keys may be loaded from a Key Fill Device
- Key ID designated in the voice or data stream
- Transmit: Encryption keys may be selected per channel, per talkgroup or per conversation
- Receive: may use preselected encryption keys or may search the device’s internally stored keys
Conventional Configurations

Data Gateway

- Fixed Station does not repeat the data signal
- Data Gateway device interfaces Data Host to Fixed Station
- Data Host outside the RFSS
  - Standard P25 Data Host Network Interface
  - Carries IP datagrams

Note:
For a complete set of CAI and IP data bearer services supported by the FDMA CAI for the Conventional Fixed Network Data configuration see section 4 of the PTIG Capabilities Guide
P25 Fixed Station Interface Configurations

• Single Site
  - Single Site RFSS

• Voting
  - Multi-Site RFSS
  - Audio Distribution
  - Audio Voting

• Multicast/Simulcast
  - Multi-Site RFSS
  - Audio Distribution
  - Audio Voting
  - Project 25 Conventional RF Subsystem
FSI – Fixed Station Interface Configurations

- Voting or multicast sub-system requires DFSI
- Capabilities of FSI + Fixed Station Sub-System working together vary considerably
- Certain capabilities subject to equipment configurations

Note:
For more information on the capabilities associated with these combinations of AFSI/DFSI and Analog/FDMA CAI air interfaces see section 11 of the PTIG Capabilities Guide.
FSI (AFSI or DFSI) may be used to connect the sub-systems directly when:

- **Single** Console Sub-System and
- **Single** fixed station or a **single** voting/multicast sub-system

Console Sub-System takes on the role of RF Sub-System

Console equipment takes on the role of the virtual Fixed Station Host
Conventional
Console and Fixed Station Interface Configurations

- RFSS/CAR performs routing Arbitration and Protocol Conversion
- AFSI or DFSI to Fixed Station Sub-System
- Conventional CSSI to Console Sub-System
Conventional

**FSI – Fixed Station Interface Configurations**

### Single Station Subsystem

- **AFSI:**
  - Use with either Air Interface
  - 2 or 4 wire analog transport,
  - clear analog voice,
  - Tone Remote Control

- **DFSI:**
  - Use with either Air Interface
  - IPv4 digital transport,
  - P25 (clear or encrypted) or PCM audio,
  - P25 control signaling
Conventional Interoperability

P25 CAI, Wireline and Security Standards Enable Interoperability

- Radio-to-Radio Interoperability
- Radio-to-Infrastructure (Fixed Station and Console)
- Encryption – Voice, Data and Keyloading
Conventional Interoperability

Identify & Adopt Best Practices for Interoperability

- APCO/NPSTC Standard Channel Nomenclature
  - Configuration for Interoperability Channels
  - Methodology Can be Applied Universally
- Key Parameters
  - RX/TX Frequency
  - RX/TX Network Access Code

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<th>Eligible Users</th>
<th>Subscriber RX Freq (MHz)</th>
<th>RX Tone or NAC</th>
<th>Subscriber TX Freq (MHz)</th>
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Identify & Adopt Best Practices for Encryption

- SAFECOM/FPIC/NCSWIC
  - P25 LMR Encryption Parameter Overview
    - Key ID
    - Traffic Encryption Key (TEK)
    - Storage Location Number (SLN)
    - Algorithm ID
  - Recommended Best Practices
    - Improved Coordination
    - National SLN Assignment PLAN
Encrypted Interoperability

- National SLN Assignment Plan
- Reserves for Values for the SLN
- Designates Use for:
  - Incident Response
  - Task Force
  - Local
  - Regional
  - National

### Appendix A: National Reserved SLN Table (6/19/15)

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<td>Single Event Use – Not to exceed 30 Days</td>
</tr>
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<td>10</td>
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<td>National Tactical Event</td>
<td>NTAC.A</td>
<td>Single Event Use – Not to exceed 30 Days</td>
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<tr>
<td>11</td>
<td>AES</td>
<td>Multiple Public Safety Disciplines</td>
<td>PS.ID.D</td>
<td>Static</td>
</tr>
<tr>
<td>12</td>
<td>AES</td>
<td>Multiple Public Safety Disciplines</td>
<td>PS.ID.A</td>
<td>Static</td>
</tr>
<tr>
<td>13</td>
<td>AES</td>
<td>National Fire/EMS/Ruace</td>
<td>NFIR.D</td>
<td>Static</td>
</tr>
<tr>
<td>14</td>
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<td>National Fire/EMS/Ruace</td>
<td>NFIR.A</td>
<td>Static</td>
</tr>
<tr>
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<td>DES</td>
<td>National Task Force Operations</td>
<td>FED.TF.D</td>
<td>One time use as needed for Special DOP</td>
</tr>
<tr>
<td>16</td>
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<td>National Task Force Operations</td>
<td>FED.TF.A</td>
<td>One time use as needed for Special DOP</td>
</tr>
<tr>
<td>17</td>
<td>DES</td>
<td>National Law Enforcement Task Force (one time only operation)</td>
<td>NLE.TF.D</td>
<td>One time use as needed for Special DOP</td>
</tr>
<tr>
<td>18</td>
<td>AES</td>
<td>National Law Enforcement Task Force (one time only operation)</td>
<td>NLE.TF.A</td>
<td>One time use as needed for Special DOP</td>
</tr>
<tr>
<td>19</td>
<td>AES</td>
<td>Federal – International Law Enforcement Interoperability</td>
<td>FED.INTL</td>
<td>When needed by operational requirement</td>
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<tr>
<td>20</td>
<td>AES</td>
<td>Public Safety – International Law Enforcement Interoperability</td>
<td>PS.INTL</td>
<td>When needed by operational requirement</td>
</tr>
</tbody>
</table>
Thank You!

Jim Holthaus
jholthaus@relm.com

Presented by:
PTIG - The Project 25 Technology Interest Group
www.project25.org – Booth 1853
Project 25 Foundations
Trunking System Configurations and Wireline Interfaces for Project 25

Karthik Rangarajan
Senior Vice President, EFJohnson

Presented by:
PTIG - The Project 25 Technology Interest Group
www.project25.org – Booth 764
Project 25: Interfaces & Services

**AIR INTERFACES**
- P25 FDMA COMMON AIR INTERFACE
  - TRUNKING Voice/Data
  - CONVENTIONAL Voice/Data
- P25 TDMA COMMON AIR INTERFACE
  - TRUNKING Voice

**WIRELINE INTERFACES**
- ISSI/CSSI
  - TRUNKING Voice/Data/Control
  - CONVENTIONAL Voice/Control
- FSI
  - Conventional Analog/Digital Voice/Control

**SECURITY INTERFACES**
- INTER-KMF

**SECURITY SERVICES**
- ENCRYPTION Voice/Data

**DATA SERVICES**
- LOCATION TIER 1 Conventional TIER 2 Trunking/Conventional

**DATA INTERFACES**
- SUBSCRIBER DATA PERIPHERAL INTERFACE
- DATA NETWORK INTERFACE

**NETWORK MANAGEMENT**

**AUTHENTICATION**

**TRUNKING**

**VOICE NETWORK MANAGEMENT**
P25 Interfaces

Not shown are encryption key management, network management and telephone interconnect interfaces.
P25 Interfaces

Not shown are encryption key management, network management and telephone interconnect interfaces.
Project 25 Trunking Common Air Interface (CAI)

- Operates on 12.5 kHz Channels
- Supports Integrated Voice and Data
- Supports 256 bit AES Encryption
- Control Channel (CC)
  - 9600 bps FDMA
- Traffic Channels
  - Voice FDMA (P25 Phase 1): 1 Talkpath / channel - 9600 bps
  - Voice TDMA (P25 Phase 2): 2 Talkpaths/channel - 12000 bps (2× efficiency)
  - DATA FDMA: 9600 bps
Project 25 Trunking Common Air Interface (CAI)

Control Channel
- Controls traffic on the network
- Assigns SU to FDMA or TDMA Voice or DATA

P25 FDMA (Phase 1) VOICE Services
- 1 talk path per channel
- Full Rate IMBE or AMBE Vocoder
- Supports Encrypted Mode

P25 TDMA (Phase 2) VOICE Services
- 2 talk paths per channel
- Half Rate AMBE Vocoder
- Supports Encrypted Mode

P25 PACKET DATA Services
- Supports Integrated Voice & Data

Key Takeaways:
- Common Control Channel (FDMA) for Phase 1 & Phase 2 voice services → Backward compatible for migration
- Vocoders are different → Voice will sound different
- P25 Phase 2 will double voice capacity for same number of channels
**Project 25 Trunking Common Air Interface (CAI)**
- A few Phase 1 and Phase 2 Interop Considerations

**P25 Phase 1/Phase 2 Interoperability Considerations:**
When there is a mix of P25 Phase 1 only and Phase 2 capable subscribers,

1. Addressing channel allocations within a site and across multi-site deployments (Phase 1 or Phase 2 channel assignments)
2. Negotiating Phase 1 or Phase 2 voice when going across RFSS boundaries (ISSI negotiations of FDMA vs. TDMA modes)
3. Deploying subscribers across an RFSS or across multiple RFSS – Mixed fleet of Phase 1 and Phase 2 subscribers
# P25 Trunking - Services

## Basic Services

<table>
<thead>
<tr>
<th>Integrated Voice &amp; Data</th>
<th>Voice</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group, Individual, Private, Broadcast, Emergency, Announcement, etc.</td>
<td>Radio to FNE, Radio to Radio, Tier 2 Location (GPS), OTAP/OTAR</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mobility &amp; Roaming</th>
<th>Voice</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration/De-Registration, Group affiliation, Intra-system roaming, Inter-system roaming</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Encryption &amp; Authentication</th>
<th>Voice</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link Layer authentication, End to end voice/data encryption, Key Management</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Supplementary Services

<table>
<thead>
<tr>
<th>Call Alert</th>
<th>Status Message/Status Update</th>
<th>Radio Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio Unit Monitoring</td>
<td>Radio inhibit/Uninhibit</td>
<td>Priority/Preemptive Priority</td>
</tr>
</tbody>
</table>
P25 Trunking - P25 Packet Data

• Data CAI
  - 9600 bps Integrated Voice & Data
  - 12.5 kHz Narrowband Channel
  - Supports Simulcast
  - 256 bit AES Encryption

• Example Applications
  - AVL or personnel tracking (uses P25 Tier 2 Location Service with GPS)
  - Over the Air Rekeying (OTAR)
  - Non P25 standard services over P25 Data
    • Over the Air programming (OTAP)
    • Text Messaging
P25 System Configurations

- Single Site
  - Single Site Trunked RFSS

- Multi Site
  - Multi-Site Trunked RFSS
    - Simulcast
    - Multicast

- Multi Site Overlay
  - Multi-Site Trunked & Conventional Overlay
    - Trunking RFSS (voice & data)
    - Conventional RFSS (e.g., paging)
P25 ISSI & CSSI - Multi-System Scenarios

Connecting RF Sub-Systems Using ISSI (no CSSI):

- Creates interoperable P25 Services across disparate systems
- Console operate across ISSI but without CSSI features;
  - Consoles behave like subscribers.

Connecting Systems Using CSSI Only:

- CSSI can be used to connect a separate Console Sub-system B, allowing console operator (Console OP) positions to control traffic on System B
  - Enables 3rd party P25 console options
- Consoles can operate on both sides of interface

Connecting Systems Using ISSI/CSSI:

- This configuration supports all P25 ISSI/CSSI features between different subsystems and a separate Console Subsystem, allowing intricate controls over vast network resources.
P25 Trunking Interfaces & Configurations

- P25 Trunking CAI Interfaces
  - Phase 1 FDMA
  - Phase 2 TDMA

- P25 Packet Data & Apps
  - Tier 2 Location
  - OTAR
  - OTAP/Text Message...

- Trunking Configurations
  - Single site
  - Multi site (simulcast, Multicast)
  - Multi site (Hybrid systems, Overlays for paging etc.)

- ISSI/CSSI for Inter-Subsystem interoperability
Thank You

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Senior Vice President, EFJohnson

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P25 Foundations
ISSI Roaming Best Practices & LMR-LTE Interoperability

Todd Perdieu
Senior Manager of Products for Harris

Presented by:
PTIG - The Project 25 Technology Interest Group
www.project25.org – Booth 746
What is ISSI/CSSI

P25 Console Interface (CSSI)

P25 RF Sub-System (RFSS) “BLUE”

Vendor X

P25 Inter Sub-System Interface (ISSI)

Vendor Y

P25 RF Sub-System (RFSS) “GREEN”

P25 Conventional Fixed Station Interface (FSI)
A) Interop with Neighbors - You are home to “BLUE” and want to talk to “GREEN” users

- Creates interoperable P25 Services across two different systems
- Console operates across ISS but without CSSI features
B) Extend your Coverage - You leave your “BLUE” coverage and roam to “GREEN”. Then have a need to talk back to your home “BLUE” System.

- Register via the ISSI on your home system on your selected talk group
- Not interoperating with you neighbor.
- System of system concept
Typical Use Cases

C) Interop with Neighbors - You leave your home coverage “BLUE” to talk to “GREEN” users.

- Register on the “GREEN” system using a “GREEN” talkgroup.
- Must be a valid user on the “GREEN” system
- Provide support for an emergency in the “GREEN” service area

![Diagram showing interop with neighbors between P25 RF Sub-System (RFSS) "BLUE" and "GREEN" with ISSI interface between vendors X and Y.]
Typical Use Cases

D) CSSI – Connected to “BLUE” system.

• Enables 3rd party Console options
• Control traffic on “BLUE” System
ISSI/CSSI Features

System to System Call Features
• P25 Phase 1 and Phase 2 Audio
• Group Call
• Emergency Group Call
• Emergency Alarm
• Encrypted Calls with AES
• Unit-to-Unit Call
• Broadcast Call
• Passing Unit ID
• Pass User Alias

Common Feature Implementations (not standardized)
• Forced Group Affiliation

Service Features
• Roaming Management
• Auto Roaming
• Link Layer Authentication

Console Centric Features
• Monitor Simultaneous TalkGroups
• Console Preempt – Dispatcher takeover
• Status Query
• Status Update
• Radio Check
• Radio Unity Monitor
• Radio Inhibit
How Does ISSI/CSSI Help you?

The Power of Choice

Promotes system autonomy
Console system options
Multi-vendor vendor networks
Competitive procurements

Increased Levels of Operation

Increases Interoperability between neighbors
Expands your coverage footprint & your neighbors footprint
System of System build outs
Security - End to End Encryption
Best Practices

Planning

System Admins have to communicate ahead of time
What systems would you visit (enable allowable id ranges)
Planned events/visitors on your system
Unplanned visitors – policy to allow, deny, or determine real time

Technology

Know your Band – Multi-band radios can help
Know your feature set – only common features will work
Unique WACN will avoid ID duplication between systems
Talk Group Management – Force affiliate, dedicated interop group
P25 and LTE Interoperability
Question:
Why P25 and not just LTE?

Answer:
Because you rely on LMR voice
And you want broadband safety features
And sometimes you cannot interact with a smartphone
Coexistence

• Can I use LMR and LTE at the same time? Yes!
• 700 MHz interference between cellular and LMR is not new.

When standing under a powerful cell site

When radios and phones are side-by-side

When the radio and LTE are combined in a single device
Combining P25 and LTE Brings Value

Eco System of Safety Applications

FirstNet P25
4G LTE Wi-Fi

Analog P25
FirstNet Verizon Wi-Fi

P25 Reliable Voice
Thank You

Todd Perdieu
Senior Manager of Products, Harris
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Project 25 Foundations
P25 Roaming and ID Duplication
P25 Standards Activity Update
P25 Compliance

Andy Davis
Chairman; TIA TR-8 Mobile and Personal Private Radio Engineering Committee
Sr. Resource Manager; P25 Standards - Motorola Solutions

Presented by:
PTIG - The Project 25 Technology Interest Group
www.project25.org – Booth 746
P25 Roaming and ID Duplication

Automatic vs. Manual Roaming
Roaming – User Experience
Roaming – Identity Management
ID Duplication
Two roaming methods often discussed in P25:

• Automatic
• Manual

What’s the difference? Let’s look at two areas:

• User Experience
• Identity Management

Note: This is all from a P25 Trunking perspective
Roaming - User Experience

Automatic Roaming (Intra and Inter system)

- “automatic roaming” refers to the radio’s ability to move from the coverage of one RF site to another without user intervention (no change to radio operating parameters)
  - In theory, the user doesn’t know it happens
  - However, P25 roaming is not completely “seamless”
- Cooperation between the two sites, including broadcasting a standardized set of information about nearby sites to the radios, helps facilitate roaming when the two sites are geographically adjacent
- The two sites (old and new) can be part of the same system (Intra-system roaming), or can be part of two separate systems perhaps connected via ISSI (Inter-system roaming)
  - Stay tuned for Identity Management discussion...
Manual Roaming (Inter system)

- “manual roaming” refers to the radio’s ability to move from the coverage of one RF site to another with user intervention to manually select radio operating parameters of the visited system.

- The radio tunes to the newly selected site frequency and attempts to register on the RF site’s control channel.

  - Again, stay tuned for the Identity Management discussion...
Roaming - Identity Management

P25 addressing

• Subscriber Unit Identity, SUID is a 56-bit identifier unique in the universe

• A trunking “system” is identified by a globally unique WACN.System ID
  o Use the *P25 Guidelines to Assign WACN & System IDs* to ensure your WACN.System ID is globally unique

• To avoid interoperability problems, the Unit ID portion of the SUID must be unique within a trunking system
P25 registration: **Automatic Roaming**

- When the radio finds a control channel the radio sends a registration request using the 56 bit home SUID (home WACN.System ID and home UID)
- Home system is notified of the request if there is an ISSI
- Request may be accepted or rejected based on visited system and/or home system authorizations
- If accepted: 24 bit working ID assigned from a pool of unused UIDs
- Working ID may be different for each registration
- Working ID is used for service requests/assignments and ID display on the visited system
- If there is an ISSI, the SUID is used for service requests/assignments and ID display across the ISSI
P25 registration: **Manual Roaming**

- When the radio finds a control channel the radio sends a registration request using the 56 bit **visited** SUID (**visited** WACN.System ID and **visited** UID)
- Home system is notified of the request if there is an ISSI
- Request may be accepted or rejected based on visited system and/or home system authorizations
- If accepted: 24 bit working ID assigned from a pool of unused UIDs and equals the UID (assigned by and unique in visited sys)
- Working ID may be different is the same for each registration
- Working ID is used for service requests/assignments and ID display on the visited system
- If there is an ISSI, the SUID is used for service requests/assignments and ID display across the ISSI
Now that we understand roaming a little better, how do we avoid interoperability problems associated with ID “collisions” within and between systems?

Well, proper planning and some discipline are necessary.

Two general principles apply:

- Managing WACN.System IDs between systems
- Managing Radio IDs within your system, and for visitors to your system
ID Duplication

• What to do ahead of time
  – First, use the TIA-102 / P25 Addressing Rules
    • Program your radio IDs to adhere to the Subscriber Unit ID, SUID, format: WACN.System.UID
  – Use the **P25 Guidelines to Assign WACN & System IDs** to ensure WACN.System ID is unique to your system
    – Remember that WACN.System is your radio’s “home”
ID Duplication

• What to do ahead of time (cont)
  • UIDs must be unique for your WACN.System ID
  • If You Have Frequent Visitors...
    • Consider giving them a UID on your system and using Manual Roaming with identity change
    • Radio owner creates a profile/personality for your system
      – Profile uses your WACN.System ID
      – Profile uses a UID that you have assigned
      – Working ID is the same for every visit
    • Visiting radios using automatic roaming
      – No ID duplication issue but...
      – Working ID may not be the same for every visit
• Final thoughts
  – Follow the P25 Subscriber Unit ID addressing rules!
    • The WACN.System.UID addressing method will facilitate the interoperability and compatibility with different P25 systems and visitors.
  – Use an ISSI connection back to another system
    • Consult your ISSI vendor or consultant for tips and tricks on managing IDs across the ISSI
  – Have a plan ahead of time for foreign visitors!
    • Set up operational procedures and have agreements in place before you need them
  – And in case you were wondering, P25 conventional only supports manual roaming...
P25 Standards Activity Update

Background
2016 & 2017 Publications
Work in Progress
P25 Security Status
Project 25 Steering Committee Approved P25 Standards list includes ~85 documents

- To date, all are produced, published and maintained by TIA TR-8 Mobile and Personal Private Radio Engineering Committee
- Overviews, Standards, Standard Tests, Telecommunications Systems Bulletins
- In addition to new documents, TIA publishes document revisions and document addendums
  - Revisions and addendum may provide clarifications, correct errors or add additional material
2016 Publications (revisions)

TIA-102 Documentation Suite Overview Rev C

- reflects TR8 progress since the last publication (2012), including new TIA publications, improved graphics, and addresses miscellaneous errata identified

Air Interfaces

- FDMA & TDMA Air Interface Measurement Methods
  - revisions will ensure that harmonics present in Class D amplifiers do not interfere with various audio measurements.

- Conventional Conformance tests
  - revisions update the list of reference documents, make general terminology clarifications and provided clarifications on test result expectations without modifying or adding any tests.

- Emergency Alarm signaling enhancements
  - addendum expands the existing emergency alarm request message to indicate that the emergency alarm request has been generated by conditions other than depression of the emergency alarm button.

Wireline Interfaces

- ISSI Messages and Procedures errata addendum
  - revision corrects several errata that have been noted since the last publication.
2017 Publications (revisions)

Air Interfaces

• FDMA Common Air Interface Standard
  o revision addresses errata that have been collected since the last publication.

• FDMA Common Air Interface Reserved Values Standard
  o revision addresses errata that have been collected since the last publication.

• Trunking Interoperability Test Standard
  o revision merges the FDMA and TDMA material and addresses an error in a call pre-emption test procedure.
Work in Progress

Air Interfaces

• New standard for a TDMA Control Channel
  o *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.*

Wireline Interfaces

• Revision to the Fixed Station Interface Standard
  o *adds additional capabilities the most significant of which is Packet Data.*

• Group and Individual Regrouping for the Trunking ISSI/CSSI Standard
  o *enable dispatch equipment connected to Trunking Infrastructures via the ISSI/CSSI to control both group and individual regrouping services. Note the control channel messaging for these services has already been standardized.*

• Revision to the ISSI Recommended Compliance Assessment Tests Bulletin
  o *Identifies ISSI tests that may be re-used for a CSSI configuration*
Work in Progress (cont.)

Security

- **Addendum to the Key Fill Interface standard**
  - Adds Key Fill to Key Management Facility, Authentication Facility and to another Key Fill device

- **Link Layer Encryption**
  - LLE provides confidentiality and replay protection for IDs and control messages
  - Note: LLE is NOT a substitute for end-to-end encryption. LLE provides confidentiality and replay protection for IDs and control messages
  - Requirements reviewed and agreed to. LLE Overview document ETG 16-049-R12 has been reviewed with agreements on many key architecture concepts.
  - Completion of this document in the APCO Project 25 Interface Committee (APIC) Encryption Task Group (ETG) enables work on other standards documents for LLE.
  - Existing standards impacted by LLE:
    - FDMA CAI TIA-102.BAAA
    - TDMA MAC TIA-102.BBAC
    - Trunking Formats (TSBKs/ MBTs) TIA-102.AABB
    - Others as needed
P25 Compliance

Background

Levels of “P25 Compliance”
“P25 COMPLIANCE” is not strictly defined but most consider “compliance” to mean:

• Adherence to published documentation

P25 SoR drives P25 Standard creation/content

P25 Standards enable interoperability

P25 Standard tests describe consistent methods for testing implementations against a published standard (Performance, Conformance and Interoperability)
Levels of “P25 Compliance”

1. Compliance in the context of the P25 SoR
   • P25 SoR is created and maintained by P25 Steering Committee’s User Needs Subcommittee (UNS)
   • UNS’ view of what interfaces, services, features, etc that should be addressed by P25 standards and/or implemented in P25 systems/equipment
   • Includes importance ranking (Mandatory, Standard Option, Standard Option-Required)
   • P25 SoR is not part of the P25 Standard
   • Compliance statements at this level mean the functionality described in the SoR has been implemented
     o P25 SoR contains high level descriptions of functionality that does not enable interoperability
     o Most SoR items trace to published P25 standards, however some do not
Levels of “P25 Compliance”

2. Compliance in the context of the P25 Standards

• Manufacturers selectively implement standard functionality based on the customers they serve
  o P25 Interfaces (Air, Wireline, etc)
  o P25 Services (Data, Security, etc)
  o P25 Features (Group call, Ind call, etc)

• Compliance statements at this level mean some set of functionality covered by the P25 Standard documents has been implemented per the document and is expected to interoperate
3. Compliance in the context of the P25 Standard Tests

- Compliance statements at this level mean the implemented functionality produces the specified results under the specified conditions for:
  - **Performance**: standard measurement methods with associated specifications (primarily applies to RF)
  - **Conformance**: standard feature operation with proper message sequence and message content
  - **Interoperability**: standard feature operation between equipment of different manufacturers
Levels of “P25 Compliance”

4. Compliance in the context of the DHS OIC CAP

- Compliance statements at this level mean:
  The functionality has been implemented per the P25 Standard document(s) and will pass the associated P25 Standard Test(s) covered by published CABs and testing has been done in CAP recognized labs and reports have been approved by DHS OIC

- **Recommended Compliance Assessment Test Telecommunication Systems Bulletins (RCAT TSBs)**
  - Created by the industry and user community TIA members that produce and maintain the P25 Standard documents and P25 Standard Test documents and endorsed by the P25 Steering Committee
  - Provided to the DHS OIC CAP Advisory Panel for consideration when drafting or revising Compliance Assessment Bulletins (CABs)
  - **RCATs** are P25 recommendations for P25 tests appropriate for use when “assessing” P25 standard compliance of a product
  - **CABs** define testing and test result reporting for the DHS OIC Compliance Assessment Program
Thank You

Andy Davis

Chairman; TIA TR-8 Mobile and Personal Private Radio Engineering Committee
Sr. Resource Manager; P25 Standards - Motorola Solutions

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March 27, 2017

Sridhar Kowdley
Program Manager
Office for Interoperability and Compatibility
First Responders Group
Science and Technology Directorate
P25 CAP in 100 Seconds
Recent Milestones

- **May 16**: P25 CAP AP meeting in Boulder, Colorado
- **Aug 16**: DHS S&T OIC releases 2016 CABs, initiating 12-month window for lab re-accreditation and equipment re-testing for P25 CAP Compliance
- **Nov 16**: DHS S&T OIC holds webinar series on Federal 508 Accessibility Requirements and broader program updates
- **Nov 16**: DHS S&T OIC publishes Draft TDMA and CSSI CABs for public comment
- **Dec 16**: DHS S&T OIC publishes an updated P25 CAP Charter

DHS S&T OIC hosts P25 CAP AP establishing meeting

DHS S&T OIC publishes Draft Encryption Requirements CAB for public comment
P25 CAP Priorities

- Conduct outreach and education efforts for public safety on P25 CAP and P25, resolving confusion on P25 CAP Compliance, Statement of Requirements and P25 standards
- Identify ways to better engage users in the development of end user requirements in the P25 standards process through the P25 CAP
- Non-Standard Encryption issue addressed
- Strengthen SAFECOM Grant Guidance language
- Support conventional conformance testing
- Finalize CABs to support Phase 2 TDMA and CSSI testing and reporting
- Encourage ISSI and CSSI Lab assessments and testing
- Start discussions with regards to P25 and MCPTT (FirstNet) interworking
Learn More

- Contact email: P25CAP@hq.dhs.gov
Using the P25 Standards and Capabilities Guide to Develop an RFP

Cheryl Giggetts
Senior Vice President, AECOM Technology Solutions

Presented by:
PTIG - The Project 25 Technology Interest Group
www.project25.org – Booth 746
Overview

Definitions:

• P25 Statement of Requirements (SoR)
• P25 Standards (TIA 102 Series)
• PTIG P25 Capabilities Guide

P25 Statement of Requirements

• P25 Mandatory Features
• P25 Standard Options
• P25 Standard Options Required

P25 Capabilities Guide

P25 RFP Development
Definitions

P25 Suite of Standards:

The P25 Standard is a collection of documents and standards adopted by the P25 Steering Committee. The TIA-102 series of standards makes up the bulk of the P25 Standard. To date, all documents included in the suite of P25 Standard Documents are created and maintained by the TIA TR-8 Engineering Committee.

PTIG P25 Capabilities Guide

The PTIG Capabilities Guide (available on the Project25.org home page) is a comprehensive guide listing features and capabilities currently covered by the P25 Standards.

P25 Statement of Requirements (SoR):

The P25 Statement of Requirements is a document developed and managed by the P25 User Needs committee. This committee is made up of Public Safety and Government practitioners, and it is open to participation by P25 product suppliers and consultants. The SoR is a living document that includes the operational requirements and features requested by the user needs sub-committee. Many are reflected in the existing P25 Suite of Standards, while others are for consideration in future P25 Standards development.
Understanding the P25 SoR

Need to understand the types of equipment features and options required.

Defined in the P25 SoR as:

• Mandatory Features (M)
• Standard Options (SO)
• Standard Option Required (SOR)

Key to success: It is critically important that you know and understand what features your stakeholders need.
Mandatory Features that all P25 systems vendors \textit{should} implement

These features include:

- Group and Individual calls
- Subscriber Registration/Deregistration and Affiliation
- Common Air Interface
- Etc.
P25 SoR Standard Options

If these features are implemented, they should be implemented according to the standard

These Standard Options include:

- Encryption
- Over The Air Rekeying (OTAR)
- Emergency Alarm
- Inter Sub-System Interface (ISSI)
- Console Sub-System Interface (CSSI)
- Etc.
P25 SoR Standard Option Required

Should be implemented if their associated Standard Option is implemented

These features include:

• AES Encryption for voice and data
• Voice calls across an ISSI
• Console Priority across a CSSI
• Etc.
Proprietary Features

Features not specified in the P25 standards
Vendor Specific
These features include:

- OTAP
- Call Patching
- Proprietary Fallback Modes (Failsoft)
  
  Note: Today a P25 Conventional Fallback Standard Exists
- Etc.

Note:
When proprietary interfaces, services and features are recognized as beneficial (by either the user community or the manufacturing community) they have been added to the standards in order to enable interoperable implementations.

This type of innovation and constant evolution of the standards is healthy and encouraged by TIA and P25
PTIG P25 Capability Guide

A Guide to Project 25 Subscriber and Infrastructure Equipment Capabilities as Standardized in the TIA-102 Series

Prepared by the Project 25 Technology Interest Group Version 1.7 March 2015

PTIG’s P25 Capabilities Guide was created and is maintained by a Working Group within PTIG

- Manufacturer and User Agency representatives active in P25/TIA-102 Standards

Intended to be an aid to identify what P25 Interfaces, Services, and Functionality are covered by published P25/TIA-102 Standards

- Assist customers in writing RFP’s that meet the P25 standards
- Compare neighboring system functionality for interoperability planning
P25 Capabilities Guide

Background and Purpose (cont.)

P25/TIA-102 Standard content is traceable to the P25 Statement of Requirements (P25 SoR)
- P25/TIA-102 Standard content is driven by the P25 SoR

Not all P25 SoR content is traceable to published P25/TIA-102 Standards
- P25 SoR includes important equipment capabilities unrelated to interoperability
- P25/TIA Standard creation lags SoR updates
- P25 Steering Committee, P25 User Needs Subcommittee, APIC Task Groups, and TR-8 subcommittees collaborate on standards work priorities
P25 Capabilities Guide
Organization

Capabilities Guide
• Identifies Interfaces, Services, and Functionality/Features in the published standards
• Organized into functional areas (Trunking or Conventional, Subscribers or Infrastructure)

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P25 RFP Development

Understand what is defined by the standards

- The Compatibilities Guide simplifies requirements from P25 SoR, and TIA documents.

Encourage Open Competitive Procurements

- Only require P25 Interfaces and features covered by published standards
- Avoid proprietary Interfaces and features that already have P25 definitions in the published P25 Standards.

Promote use of 3rd Party P25 Subscriber Units
Thank You!

Cheryl Giggetts
Senior Vice President, Technology Solutions
email: cheryl.giggetts@aecom.com
P25 Market and FAQs

Chris Lougee
Principal, 5 x 9 Communications

Presented by:
PTIG - The Project 25 Technology Interest Group
www.project25.org
World-Wide Penetration

P25 systems in 83 countries ...and increasing
15 Base Station/ Repeater Manufacturers

AIRBUS DS COMMS
CODAN RADIO
EF JOHNSON
ETHERSTACK
HARRIS CORPORATION
ICOM AMERICA
JVC KENWOOD
MIDLAND RADIO
MOTOROLA SOLUTIONS
POWERTRUNK (TELTRONIC)
RELM WIRELESS
SIMOCO
SPECTRA ENGINEERING
STANDARD COMM PTY LTD – GME
TAIT COMMUNICATIONS
13 Mobile & Portable Radios Manufacturers

COBHAM
EF JOHNSON
HARRIS CORPORATION
ICOM AMERICA
JVC KENWOOD
MIDLAND RADIO
MOTOROLA SOLUTIONS
RELM WIRELESS
SIMOCO
STANDARD COMM PTY LTD – GME
TAIT COMMUNICATIONS
TECHNISONICS
VERTEX STANDARD
1 Pager Manufacturer
7 Vehicular Repeater Manufacturers

- CATALYST
- CODAN RADIO
- FUTURECOM SYSTEMS
- HARRIS CORPORATION
- MOTOROLA SOLUTIONS
- RF TECHNOLOGY
- SIMOCO
13 Console Manufacturers

AVTEC
CATALYST
EF JOHNSON
HARRIS CORPORATION
IDA CORPORATION
INTER TALK SYSTEMS
MOTOROLA SOLUTIONS
POWERTRUNK
RF TECHNOLOGY
SIMOCO
TAIT COMMUNICATIONS
TELEX RADIO DISPATCH
ZETRON
14 Network Providers

AIRBUS DS COMMS
CISCO
CODAN RADIO
EF JOHNSON
ETHERSTACK
HARRIS CORPORATION
ICOM AMERICA
IDA CORPORATION
JVC KENWOOD
MOTOROLA SOLUTIONS
POWERTRUNK
SIMOCO
TAIT COMMUNICATIONS
TELEX RADIO DISPATCH
7 Software Providers

CATALYST
CISCO
DVSI
ETHERSTACK
GENISIS GROUP
IDA CORPORATION
SIMOCO
8 Test Equipment Manufacturers

AECOM
CISCO
COBHAMP
COMPLIANCE TESTING
ETHERSTACK
LOCUSUSA
SIMOCO
VALID8
## 17 System Integrators

- AECOM
- AIRBUS DS COMMS
- BAI
- CISCO
- CODAN RADIO
- DVA CONSULTING
- EF JOHNSON
- 5X9 COMMUNICATIONS
- GENISIS GROUP
- HARRIS CORPORATION
- ICOM AMERICA
- IDA CORPORATION
- MOTOROLA SOLUTIONS
- RF TECHNOLOGY
- POWERTRUNK
- SIMOCO
- TAIT COMMUNICATIONS

---

![Full Life Cycle Support](chart.png)

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![P25 SOLUTION CENTRE](diagram.png)
11 Consultants
AECOM
BAI
BLACK & VEATCH
COMPLIANCE TESTING
DVA CONSULTING
FEDERAL ENGINEERING, INC
5X9 COMMUNICATIONS
IDA CORPORATION
SIMOCO
TELEVATE
TIMCO ENGINEERING
# Multiple Vendors

## 41 Total Project 25 Product and Service Providers

P25 Devices

2015 - 1.19M Units
2020 - 2.3M Units
CAGR – 14%

Source: TechNavio
2141 Project 25 Systems
  • US, Canada, Australia, New Zealand and the UK.

P25 Conventional Systems – 1299 Systems
  - Digital only or mixed mode analog and digital

25 Trunking Systems – 842 Systems
  - P25 Phase1 or P25 Phase 2

P25 systems in over 80 other nations
P25 Systems by Frequency Band

Source: PTIG Trunking and Conventional Systems Lists June 2016
P25 Systems by Type of User Agency

Source: PTIG Trunking and Conventional Systems Lists June 2016
Frequently Asked Questions (FAQ)

Where can I view the latest list of P25 Standards Documents available?

Where can I get a copy of P25 Standards documents?

Where can I view the latest Changes and Updates to the P25 Standards and future work in progress?

Are supplementary services in the P25 Standard available with multi-vendor offerings?

What is the P25 Statement of Requirements (SoR)

How do I find which operational requirements and features are covered in the P25 Suite of Standards?

• How are P25 Standards documents created?

• What is the status of the P25 Phase 2 Standard suite?

• What is the status of P25 Phase 2 equipment availability?

• When will the P25 Standard be complete?

• What is going on with the Compliance Acceptance Program (CAP) testing for Project 25 equipment?

• Where can I view CAP testing results?

• Are CAP tested products “Certified” to meet P25?

• How are P25 Test Documents created?

• What are RCATs?

• What are CABs?

• Is Project 25 Public Safety Grade?

• What are the benefits of using P25 radio equipment on the Fire ground?

• What is the difference between Automatic roaming and Manual roaming in a P25 System?

• We are going to a new P25 system in our rural area. All of the systems around us are conventional analog. How can we interoperate?
# Project 25 Technology Interest Group

**Members Exhibiting**

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**Sustaining Members**

**Founding Members**

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**Visit PTIG**
Booth # 746
IWCE 2017

**Our Member Organizations As Exhibitors Also Say Thank You**
Thank You!

Chris Lougee
5 x 9 Communications

email: chrislougee@5x9comm.com

Presented by:
PTIG - The Project 25 Technology Interest Group
www.project25.org
P25 Foundations
System Technology Updates for 2017