International Wireless and Communications Expo
College of Technology
Las Vegas, Nevada
March 24, 2014

Project 25 Foundations: System Interface Updates for 2014

Presented by:
PTIG - The Project 25 Technology Interest Group
www.project25.org – Booth 6070

Program Agenda

- **PTIG Introduction & Workshop Overview**
  - Neil Horden, Federal Engineering Inc.
- **Project P25; The Goals, The Process, The Standards**
  - Nick Pennance, Tait Radio Communications
- **Project 25; 25th Anniversary Progress Check**
  - Chris Lougee, ICOM America
- **Project 25 Technology Interfaces & Services**
  - Andy Davis, Motorola Solutions
- **Project 25 Conventional Systems**
  - Andy Davis, Motorola Solutions
- **Project 25 Security Services Update**
  - Bill Janky, Harris Public Safety & Professional Communications
- **Project 25 Trunking Systems**
  - Cynthia Wenzel Cole, Cynergyze Consulting
- **PS LTE Broadband and Project 25**
  - Cynthia Wenzel Cole, Cynergyze Consulting
- **Open Forum and Discussion, Questions and Answers**
  - Neil Horden, Federal Engineering Inc.

Take Away Topics to Look For

- Introduction to this and other P25 sessions of interest at IWCE
- A look at P25 in the market and supporting resources
- P25 Standards, the Process, and Why P25 is Useful to Users
- The many P25 Features and Interfaces
- A look at the Interface Definitions and Standards Completed
- The Reality of Multiple Vendor Interoperability with P25
- And finally, who is PTIG?

Who and What is *PTIG*?

Project 25 Technology Interest Group

Who we are:

- Supporters of Project 25 technology, nurturing Project 25's adoption, growth, and expansion
- A venue fostering an atmosphere encouraging Users to contribute to and benefit from a close interaction with the vendor community driving the on-going development of the Project 25 Standards

Set your browser to **www.project25.org**

What do we do:

- Provide an information 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 such as THIS SESSION.

P25 Presentations at IWCE College of Technology

- Monday AM
  - **Project 25 Foundations and System Interface Updates for 2014**
  - Session # M103 (This is Here and Now!!)
  - 8:30AM -12:00PM, Room N232

- Tuesday AM
  - **P25 User's Perspective and Customer Applications Update for 2014**
  - Session # T301
  - 8:30AM -12:00PM, Room N232

P25 Presentations at IWCE through This Week

- A Guide to Interoperability and “Open” Standards
- W03 - Wednesday, 03/26/2014, 11:00AM -12:15PM, Room S228.

- NPSTC Presents Current Public Safety Issues
- W07 - Wednesday, 03/26/2014, 11:00AM -12:15PM, Room S229.

- Building Interoperable Communications between Departments
- W11 - Wednesday, 03/26/2014, 1:15PM - 2:30PM, Room S228.

- Get Exactly What You Want: System Specifications, RFPs and Procurement
- W12 - Wednesday, 03/26/2014, 1:15PM - 2:30PM, Room S230.

- Migrating to P25
- TH05 - 03/27/2014, 9:45AM -11:00AM, Room S231.

P25 Presentations at IWCE through This Week

- DHS Update of the National Emergency Communications Plan
- TH07 - Thursday, 03/27/2014, 9:45AM -11:00AM, Room S229.

- Firefighter Tech: Radio Interference and Accessories
- TH23 - Thursday, 03/27/2014, 2:00PM - 3:15PM, Room S229.

- LMR and LTE: A Multi-Network Architecture for Future Communications
- TH26 - Thursday, 03/27/2014, 3:30PM - 4:45PM, Room S232.

- Migrating P25 Phase 1 to Phase 2: Best Practices
- F11 - Friday, 03/28/2014, 11:10AM -12:10PM, Room S231.

- All Things Considered: Building a Public Safety System for the 21st Century
- F12 - Friday, 03/28/2014, 11:10AM -12:10PM, Room S229.

PTIG Commercial Members

- AECOM
- Aeroflex
- Airwave Solutions
- Anritsu
- ARINC
- Avtec
- Cassidian Communications
- Catalyst Communications
- Cisco Systems
- Cobham Avionics
- Codan Radio (formerly Daniels)
- Cynergyze
- Datron
- DVSI
- EF Johnson Technologies
- Etherstack
- Federal Engineering, Inc
- Genesis Group
- Harris Corporation
- Icom America
- IDA Corporation
- Kenwood Usa
- Midland Radio
- Moducom
- Motorola Solutions
- Pantel International
- Powertrunk
- Radio Communications Solutions
- Raytheon Civil Communications
- Relm Wireless
- Simoco
- Spectra Engineering
- Standard Comm Pty Ltd - GME
- Tait Communications
- Technisonic
- Telex Radio Dispatch
- Thales Defense & Security
- Vertex Standard
- Wireless Pacific
- Zetron

Project 25 Resources

PTIG Member Organizations	Fixed Stations & Repeaters	Mobile & Portable Equipment & Subscribers	Consoles	Networks	Software	Test Equipment	Systems Integration	Consultant Services
AECOM						■	■	■
AEROFLEX						■		
AIRWAVE SOLUTIONS							■	■
ANRITSU						■		
ARINC							■	■
AVTEC			■					
CASSIDIAN COMMUNICATIONS	■			■			■	
CATALYST COMMUNICATIONS			■		■			
CISCO SYSTEMS				■	■			
COBHAM AVIONICS		■						
CODAN RADIO (FORMERLY DANIELS)	■			■			■	
CYNERGYZE							■	■
DATRON		■						
DVSI					■			
EF JOHNSON TECHNOLOGIES	■	■	■	■			■	
ETHERSTACK				■	■	■		
FEDERAL ENGINEERING, INC							■	■
GENESIS GROUP					■		■	
HARRIS CORPORATION	■	■	■	■			■	
ICOM AMERICA	■	■		■			■	
IDA CORPORATION		■	■	■	■		■	■
KENWOOD USA	■	■		■				
MIDLAND RADIO	■	■						
MODUCOM			■	■				
MOTOROLA SOLUTIONS	■	■	■	■			■	
PANTEL INTERNATIONAL			■					
POWERTRUNK	■		■	■			■	
RADIO COMMUNICATIONS SOLUTIONS							■	■
RAYTHEON CIVIL COMMUNICATIONS	■	■	■	■		■	■	
RELM WIRELESS	■	■						
SIMOCO	■	■					■	
SPECTRA ENGINEERING	■							
STANDARD COMM PTY LTD - GME	■	■						
TAIT COMMUNICATIONS	■	■	■	■			■	
TECHNISONIC		■						
TELEX RADIO DISPATCH			■	■				
THALES DEFENSE & SECURITY		■						
VERTEX STANDARD		■						
WIRELESS PACIFIC	■							
ZETRON			■	■				
40	16	17	13	16	6	5	18	7

COMPANY NAME	BOOTH #
Aeroflex	5051
Anritsu Company	7000
Avtec, Inc.	7019
Cassidian Communications	1007
Catalyst Communications Technologies, Inc.	2055
Codan Radio Communications Div.	8027
Datron World Communications, Inc.	1049
EFJohnson Technologies	4009; 4019
Etherstack	7009
Genesis Group, The	7056
Harris Corporation	3055
Icom America, Inc.	3032
IDA Corporation	2070
Kenwood USA Corporation	2001
Midland Radio Corporation	4121
ModUcom	4115
Motorola Solutions	5021
Powertrunk	7001; 2112
Raytheon Company	9001
RELM Wireless Corporation	5057
Rockwell Collins ARINC	3096
Simoco	9019
Tait Communications	7071
Telex Radio Dispatch	4071
Thales Defense & Security, Inc.	6009
Vertex Standard	5033
Zetron	5001

PROJECT 25 TECHNOLOGY INTEREST GROUP

Visit PTIG in Booth # 6070

OUR MEMBER ORGANIZATIONS AS IWCE EXHIBITORS ALSO SAY

THANK YOU

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Project 25

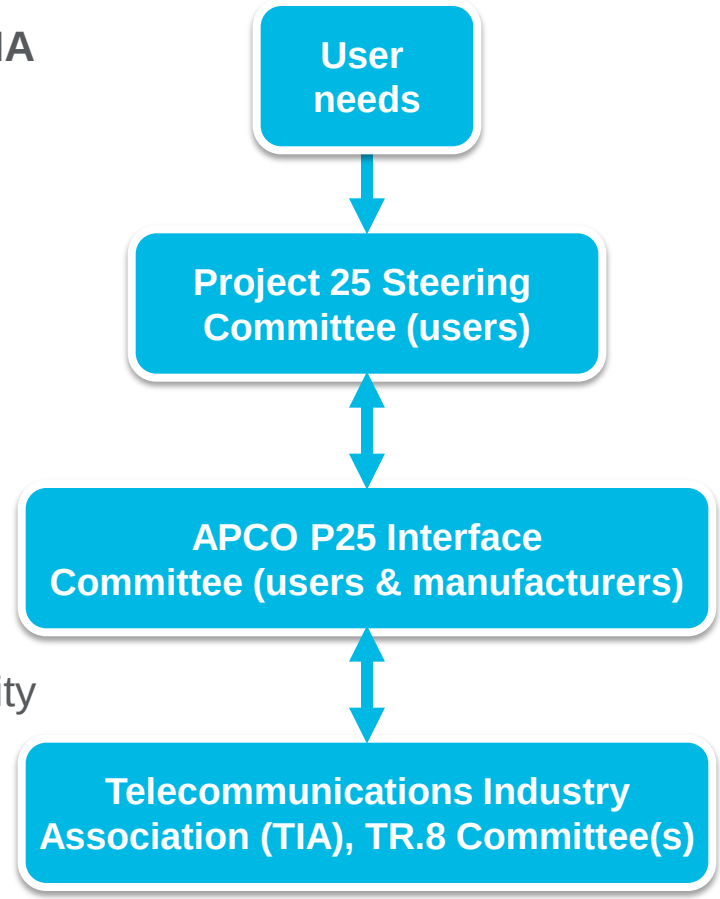
Nick Pennance

Project 25: Agenda

- A Brief History of P25
- The Goals of P25
- The User Requirements
- The Standards
- Interoperability
- Did P25 Meet it Goals?

Project 25: History

- **Designed *for* public safety *by* public safety**
- **Developed in partnership between APCO and TIA**
- **Project 25 formed in 1989 with the initial standards released in 1995**
  - P25 is a suite of mobile radio standards and bulletins which define interoperable communications for emergency services
  - ***They are continuing to evolve.***
- **The result?**
  - True multi-source procurement and interoperability
  - Smooth migration from analog while retaining backwards compatibility

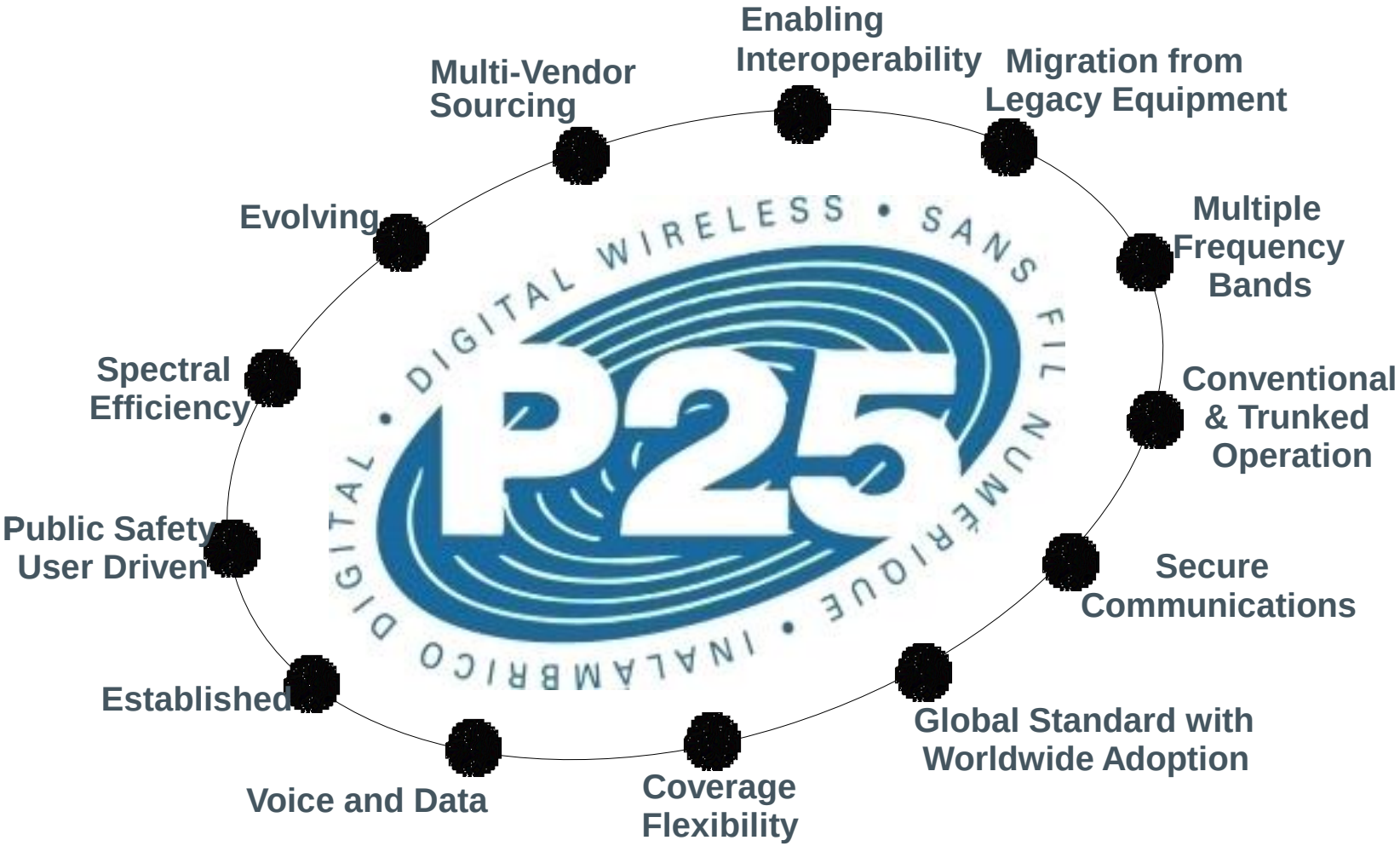


Project 25: The Goals

- **To create a digital radio standard for public safety that:**
  - Uses radio spectrum efficiently
  - Is **interoperable**
  - Can by provided by **multiple vendors**
  - Is easy to use

- **This standard technology should be:**
  - Frequency independent
  - Should be compatible with existing equipment
  - Enable gradual migration from existing systems
  - Offer coverage as close as possible to existing analog coverage
  - Able to integrate both voice and data

Project 25: The Goals



Project 25: The User Requirements

Public safety communication users are responsible for providing and maintaining their user needs in a system requirements document.

- Project 25 is the only user-driven, land mobile radio standard that currently exists.

The Steering Committee, with the involvement of its Project 25 User Needs Subcommittee (P25 UNS), establishes the priorities and scope for technical development by TIA of new and revised P25 standards.

P25 standards are driven by the user-defined P25 Statement of Requirements document known as the P25 SoR.

- The P25 SoR plays an essential role in Developing standards that meet users' needs

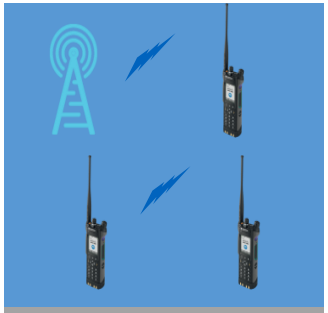
The P25 UNS updates the SoR every other year to clarify requirements, add new and to remove outdated requirements

Project 25: A Suite of Standards

- **The P25 Standard is not just one document.**
  - It is a suite of over 75 standard documents and over 25 TIA Telecommunication Systems Bulletins.
    - Over 125 documents have been developed and published supporting the standards and features offered in the Project 25 suite
  - The P25 suit of standards defines the system interfaces and services offered by P25
  - P25 Documentation Suite Overview (TSB-102-B) describes how the users and manufacturers envision the P25 system.
  - By dividing the P25 system up at defined standardized interfaces lets manufacturers develop products specific to their areas of expertise
    - This enables users to buy products that meet their specific needs.
    - The Goal is to provide users the flexibility to choose from various manufacturers' offerings to build out their P25 systems

Project 25: Interfaces & Services

AIR INTERACES



P25 FDMA COMMON AIR INTERFACE

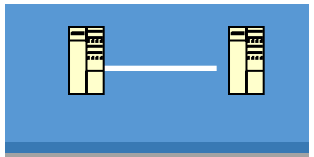
TRUNKING
Voice/Data

CONVENTIONAL
Voice/Data

P25 TDMA COMMON AIR INTERFACE

TRUNKING
Voice

WIRELINE INTERFACES



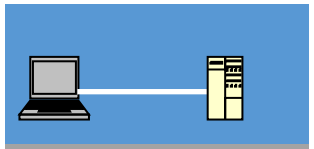
ISSI/CSSI

TRUNKING
Voice/Data/Control

CONVENTIONAL
Voice/Control

FSI

Conventional
Analog/Digital
Voice/Control



NETWORK MANAGEMENT

SECURITY INTERFACES

INTER- KMF

KEY FILL

SECURITY SERVICES

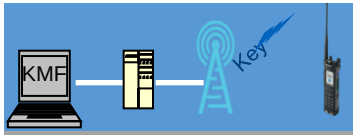
ENCRYPTION

Voice/Data

AUTHENTICATION

TRUNKING

DATA SERVICES



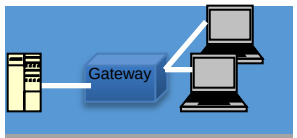
OTAR

TRUNKING/CONVENTIONAL

LOCATION

TIER 1
Conventional
TIER 2
Trunking/Conventional

DATA INTERFACES



DATA NETWORK INTERFACE

SUBSCRIBER DATA PERIPHERAL INTERFACE

Project 25: The Documents

- **Over 125 documents have been developed and published supporting the Project 25 suite of standards and features**

- **The organization of the standards divides the suite into documents relating to P25 system interfaces, services, and equipment.**

- **For each P25 interface, service, and equipment item there is a set of documents that:**
  - Describes and specifies the appropriate standards
  - Describes the tests to demonstrate conformance, performance and interoperability of the offered interface, service, and equipment
  - Describes the suite of tests selected to demonstrate compliance of the interface, service or equipment

Project 25: Describe and Specify

- **Two types of documents are used to describe and specify the interface, service, or equipment**

- **The Overview document**
  - Typically an *informative* Telecommunications Systems Bulletin (TSB) that describes the operation and function associated with a standard.
  - Provides background information relating to the P25 SoR, shows its relationship to the overall P25 system model, and provides guidance to users, system designers, and manufacturers

- **The Protocol documents**
  - These documents provide the required messages, formats, and specifications necessary for the P25 interfaces, services, and equipment to be interoperable and meet the Project 25 Statement of Requirements.

Project 25: Enabling Interoperability

TIA-102 STANDARDS DOCUMENTS	**CORE DEFINITION DOCUMENTS**	**USED TO ENABLE DEVELOPMENT**
	TESTING DOCUMENTS	**USED TO VERIFY IMPLEMENTATION**

Core Definition documents are those TIA-102 standards documents that enable manufacturers to independently develop and implement interoperable equipment.

Test documents are those TIA-102 standards documents that enable manufacturers to verify that their product implementation adheres to the respective core definition documents

The TIA-102 suite of standards are in <u>various stages of completion</u> for each of the P25 Interfaces and Services

Project 25: Tests published by TIA

- **Interoperability Testing**
  - Interoperability testing includes functional testing between manufacturer A's equipment and manufacturer B's equipment per the Project 25 standard.

- **Performance Testing**
  - Performance testing includes measurements that verify product specifications as specified in the P25 standard.

- **Conformance Testing**
  - Conformance testing includes verification of the messages as specified in the P25 standard.

- **Recommended Compliance Assessment Tests (RCAT)**
  - Subset of tests collected from above test documents related to a specific interface or service

Project 25: Compliance Assessment

- **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**
  - Against a key subset of the P25 Standards
  - Performed in CAP recognized labs

- **Published results**
  - After testing SDOCs and STRs are
  - published by the DHS on the
  - Responder Knowledge Base

- **The Responder knowledge Base has moved - www.llis.dhs.gov**

Project 25: Did P25 meet its Goals?

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

Project 25: Today

- **P25 has met its Goals**
  - P25 Equipment and services are available from over 36 vendors
  - Adopted worldwide
  - Public safety professionals continue to be part of the standards process
  - Spectrally Efficient
  - Supports both Trunked & Conventional operation
  - Multiple configurations such as multicast, simulcast, direct/simplex operation, repeaters, voting, single-site, and multi-site
  - Supports multiple frequency bands
  - Supports Security Services
  - Improved audio quality over analog

and its continuing to evolve……

Project 25: Work in Progress

- **Enhanced Security Services**
  - Link Layer Encryption
  - Link Layer Authentication
  - Inter-KMF Interface
  - KFD Updates
  - OTARUpdates

- **Public Safety requirements for BB interfacing with P25**
- **Performance, Conformance and Interoperability Tests**
- **Packet Data**
- **Location Services**
- **Dynamic Regrouping**

Project 25: The Future

- **Key Fill Interface**
- **Link Layer Encryption**
- **FSI Messages and Procedures**
- **Security Services Overview**
- **OTAR Conformance & Interoperability**
- **Data Application Suite**
- **Dynamic Regrouping**
- **ISSI Regrouping**
- **ISSI Supplementary Data Conformance, Performance and Interoperability Tests**
- **FSI Messages and Procedures**
- **FSI Conformance Tests**
- **Conventional Console Conformance and Interoperability**
- **Packet Data Services**
  - Radio Management Protocol
  - Data Host Network Interface
  - Mobile Data Peripheral Interface
  - Conventional Management Services
  - Data Security Specification

Project 25

25th Anniversary Progress Check

Chris Lougee
Vice Chair, TIA Private Radio Section

Vice President, Icom America, Inc.

Initial principles & promises

Project 25 - Five Original Goals

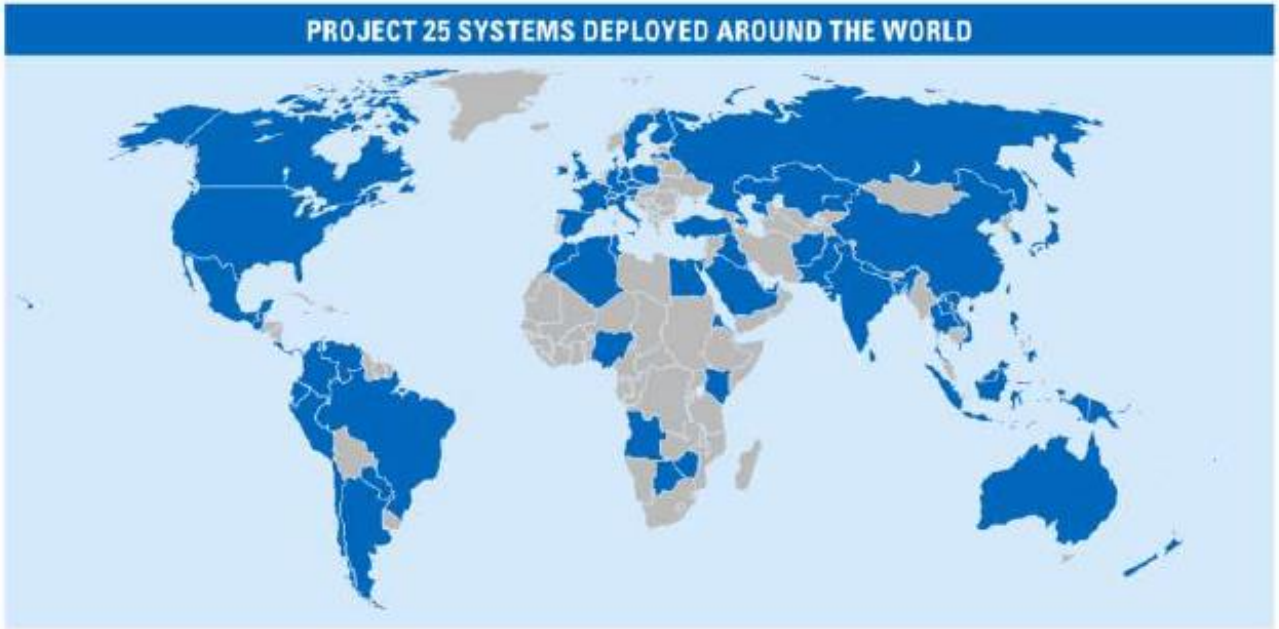
1. Competition in system life-cycle procurements
2. Graceful Migration (Backward & Forward)
3. Interoperability
4. Spectrum Efficiency
5. User-Friendly Equipment

Is Project 25 a Success?

- Initial principles and promises – *have they been met?*
- World wide penetration – *has it occurred?*
- Multiple vendors of products and services – *is there choice?*
- Competition – *do they compete for your business?*
- Interoperability – *does it exist in meaningful tiers?*
- Scalable Solutions – *are they available to fit your needs?*
- Adoption rate in the U.S. – *are P25 systems being deployed?*
- Future trends – *are deployments increasing?*
- Spectrum Efficiency – *has it been achieved?*
- Range of support resources – *are they readily available?*
- P25 – *will it meet Public Safety needs for another 25 years?*

World wide penetration ?

- Project 25 systems are deployed in 83 countries



Afghanistan
Algeria
Angola
Antigua and Barbuda
Argentina
Australia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Bermuda
Botswana
Brazil
Brunei
Canada
Chile
China
Colombia
Costa Rica
Czech Republic
Denmark
Ecuador
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Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Puerto Rico
Russia
Saudi Arabia
Singapore
Slovenia
South Korea
Spain
Sri Lanka
Sweden
Switzerland
Taiwan
Thailand
Trinidad and Tobago
Tunisia
Turkey
United Kingdom
United States
United Arab Emirates
Venezuela
Vietnam
Zimbabwe

Multiple Vendors ?

38 Vendors for Project 25 Equipment and Services

16 fixed station/repeater suppliers

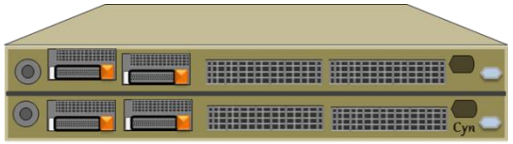
17 Subscriber suppliers

13 console suppliers

16 network providers

5 test equipment suppliers

7 consultant services



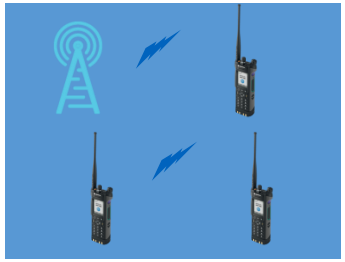
Available in VHF, UHF, 700, 800, and 900 MHz

Interoperability ?

- TIA-102 suite of standards
  - 77 Standards documents completed
  - Interoperable digital Project 25 equipment
  - Common Air Interface
  - Fixed Site “Wireline” Interfaces
- Compliance Assessment Program
- Backwards compatibility
- P25 Capabilities Guide
- Tiered interoperability

Project 25 Common Air Interfaces

AIR INTERACES



P25 FDMA COMMON AIR INTERFACE

TRUNKING OPERATION

CONVENTIONAL OPERATION

P25 TDMA COMMON AIR INTERFACE

TRUNKING OPERATION

Phase 1

P25 FDMA Common Air Interface

- Most widely deployed
- Conventional and Trunking Operation

Phase 2

P25 TDMA Common Air Interface

- Trunking Operation
- Voice only

P25 Wireline Interfaces

- Interface standards
  - Inter-RF Sub-System Interface –ISSI
  - Console Sub-System Interface – CSSI
  - Fixed Station Interface - FSI
  - Telephone Interconnect
- Maintain P25 functionality beyond the air interface
  - Eliminate translators/gateways/application shifts
- Multiple Vendor Integration Demos
  - ISSI - APCO 2007 in Baltimore
  - FSI/CSSI - IWCE 2013
- ISSI, FSI, CSSI successfully deployed
  - Expanding Vendor Introductions for FSI and CSSI.
- Improves choices and options
- Multiple vendor sourcing beyond subscribers only

Compliance Assessment Program

- Developed to improve confidence in purchasing P25 land mobile radio (LMR) equipment
- Ensures equipment
  - complies with P25 standards
  - capable of interoperating across manufacturers
- Suppliers declaration of compliance - SDocs
  - detail standardized test reports,
  - product tested
  - version tested
  - other vendors tested against and pass/fail results for each feature.
- Test results by CAP accredited labs
- Managed by DHS OIC
- Grant guidance by DHS OEC

https://www.llis.dhs.gov/knowledgebase/certifications-and-declarations

Homeland Security

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> Knowledge Base > RKB > Certifications & Declarations

Certifications & Declarations

The RKB provides basic information about specific equipment that has a confirmed certificate or declaration related to the Project 25 Program (P25), Standardized Testing and Evaluation Program (STEP), or the Integrated Public Alert & Warning System (IPAWS) program. Basic information is provided for each piece of equipment and includes the Summary Test Result and the Supplier's Declaration of Compliance (SDoC), which have been submitted to FEMA for publication.

If you are a supplier that has updates to existing certification and declaration records published here or have new certifications and declarations information to publish here, please send an email to FEMA-NIMS@dhs.gov with the following information:

Project 25 (P25)

- Equipment Name
- Certification and Declaration Type (indicate P25, IPAWS, or STEP)
- SDoC Number
- P25 CAP Recognized Lab Code(s)
- SDoC Issue Date
- Equipment Type
- Installed Options
- Declarant
- Other Devices Tested
- Installed Vocoder
- Copies of the STR and SDoC in PDF format

Integrated Public Alert & Warning System (IPAWS)

- Equipment Name
- Certifications and Declaration Type (indicate P25, IPAWS, or STEP)
- SDoC Number
- SDoC Issue Date
- Installed Options
- Declarant
- Copies of the STR (or Program Test Report) and SDoC in PDF format

Responder Knowledge Base Pages

Authorized Equipment List (AEL)

Interactive Authorized Equipment List (AEL)

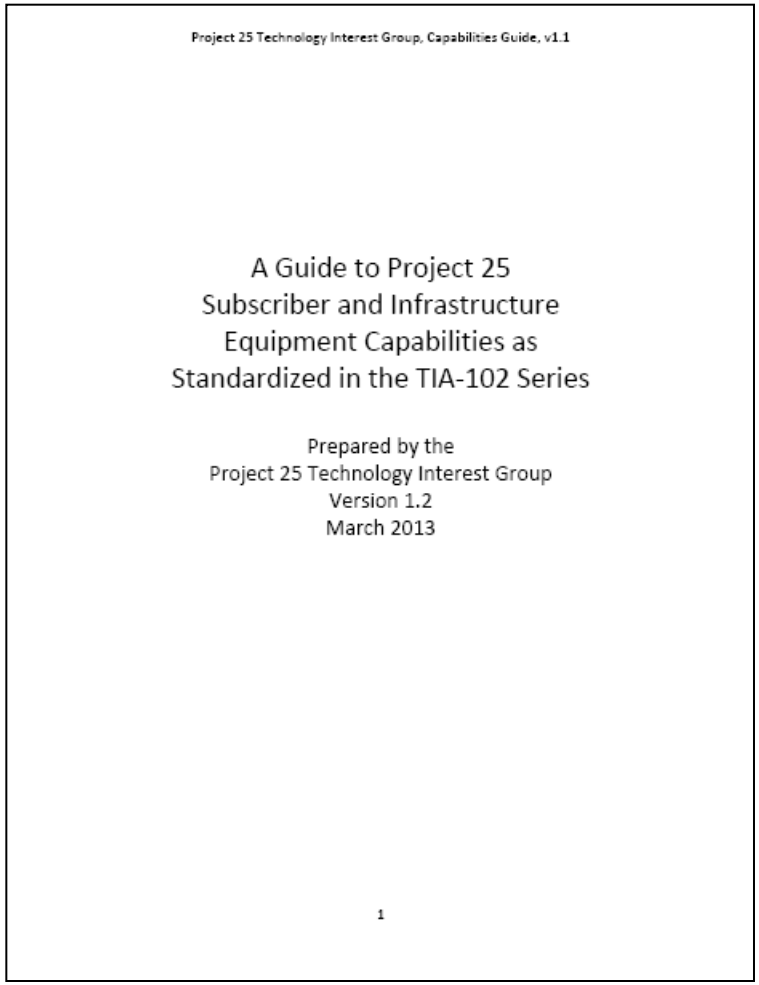
Standards Search

Certifications & Declarations

Certifications & Declarations Search

Contact Us

http://www.project25.org/documents/ptig-suggested-technical-documents/190-ptig-guide-to-p25-capabilities



Project 25 Technology Interest Group, Capabilities Guide, v1.1

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 1.2
March 2013

1

PTIG GUIDE TO P25 CAPABILITIES

P25 Capabilities Guide

Published TIA-102 standards

- Identify P25 services and features expected to interoperate

Radios or infrastructure may contain different services and features

- TIA-102 series of published standards - *All or several of these features*
- SoR features and services not published in the standards – *may not interoperate without a published standard*
- Manufacturer specific features – *useful for some users but not expected to interoperate*

Capabilities Guide

- Identifies services and features in the published standards
- Organized into functional areas *(Trunking or Conventional, Subscribers or Infrastructure)*
- Radios or infrastructure should be expected to interoperate using the listed features and services

Last but not least…
P25 Backward Compatibility

- **Project 25 Requires Backward Compatibility**
  - **From FDMA/P25 to Analog/Legacy**
  - **From TDMA to FDMA**
  - **Migrate with a smooth cut over, retaining existing radios.**
  - **Fully compliant with current RF licensing and spectrum policy.**

Scalable Solutions

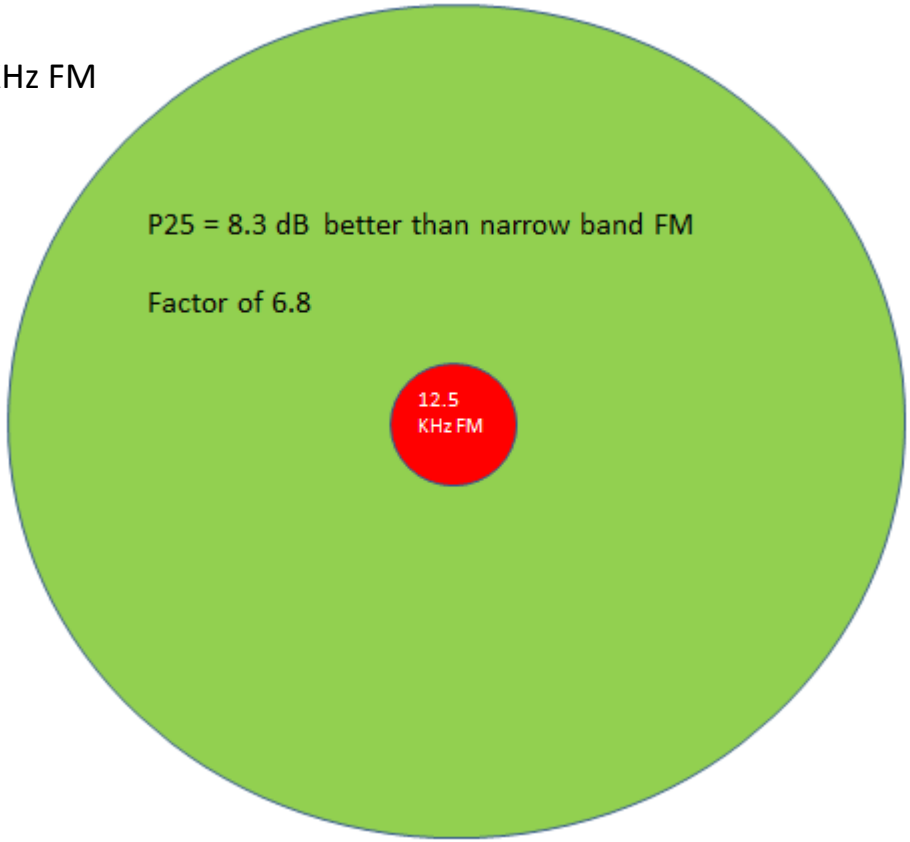
Mix-match between Trunked, Conventional, Site Linking, Wide Area, or Stand Alone

Configuration Supported	Trunking	Conventional	Description/Benefit
Multicast	✓	✓	Enables coverage of wider areas with fewer transmitter sites when compared to simulcast
Simulcast	✓	✓	Enables reuse of frequencies to increase coverage penetration of a given area and for spectral efficiency
Direct/Simplex	Supported in SUs for off-network operation	✓	Enables radio to radio communication without fixed infrastructure. Quicker communication for onsite scenarios such as a fire ground
Repeated	✓	✓	Enables a radio call to be repeated from one frequency to another, enabling communications over a larger geographic area
Voting	✓	✓	Improved inbound communications for portable radios
Single Site	✓	✓	Enables radio communications within one site's worth of coverage
Multi-Site	✓	✓	Enables radio communications over several site's worth of coverage

Improved Coverage -

P25 is 8.3 dB better than narrowband FM

Relative coverage P25 digital to 12.5 KHz FM

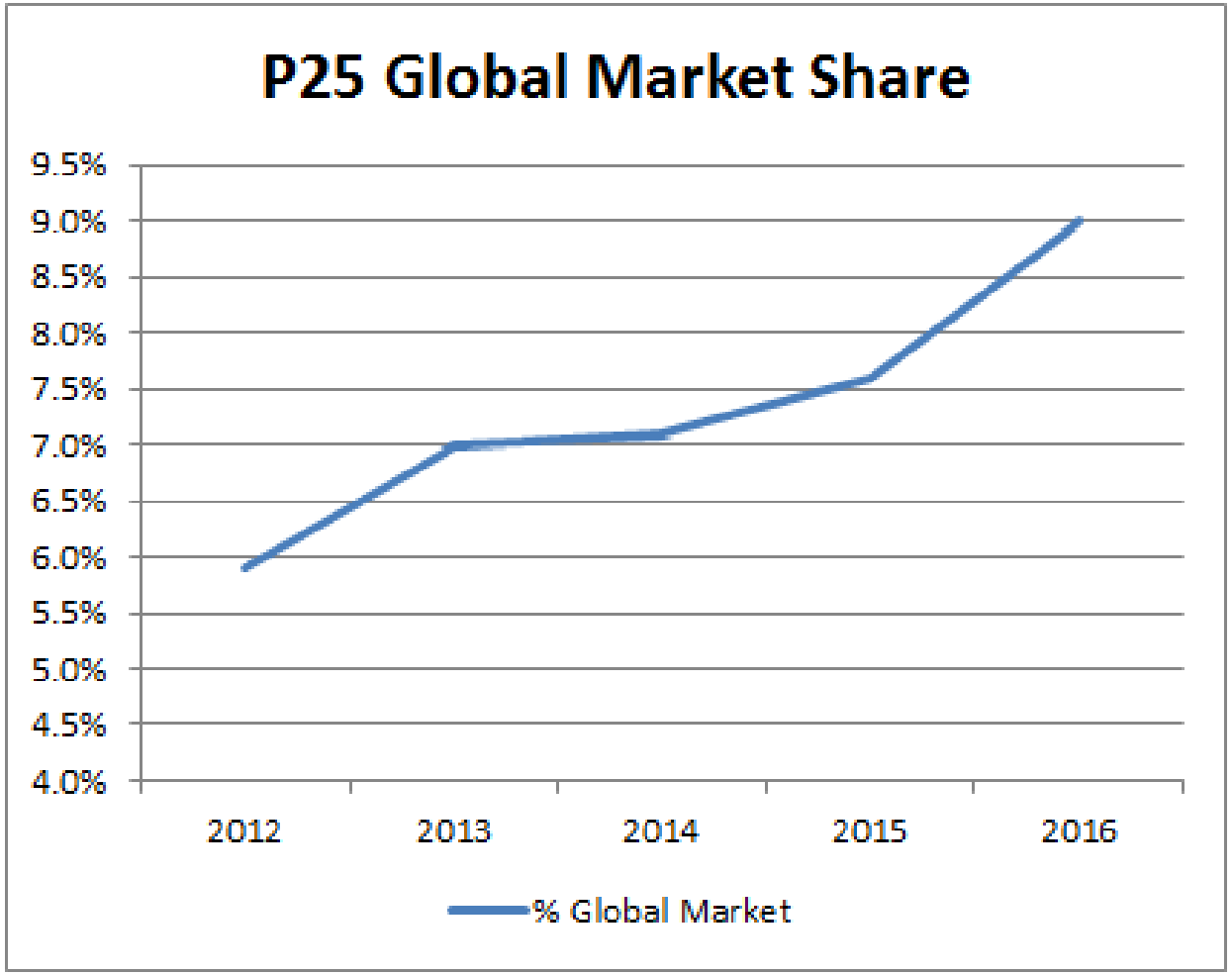


- 25KHz were migrated to 12.5 KHz analog to meet deadline
- Significant loss in coverage
- P25 C4FM @ 12.5 kHz more efficient than 12.5 kHz FM
- Most would see a dramatic improvement in coverage

Engineering analysis by Jay M. Jacobsmeyer, P.E.,Pericle Communications Company

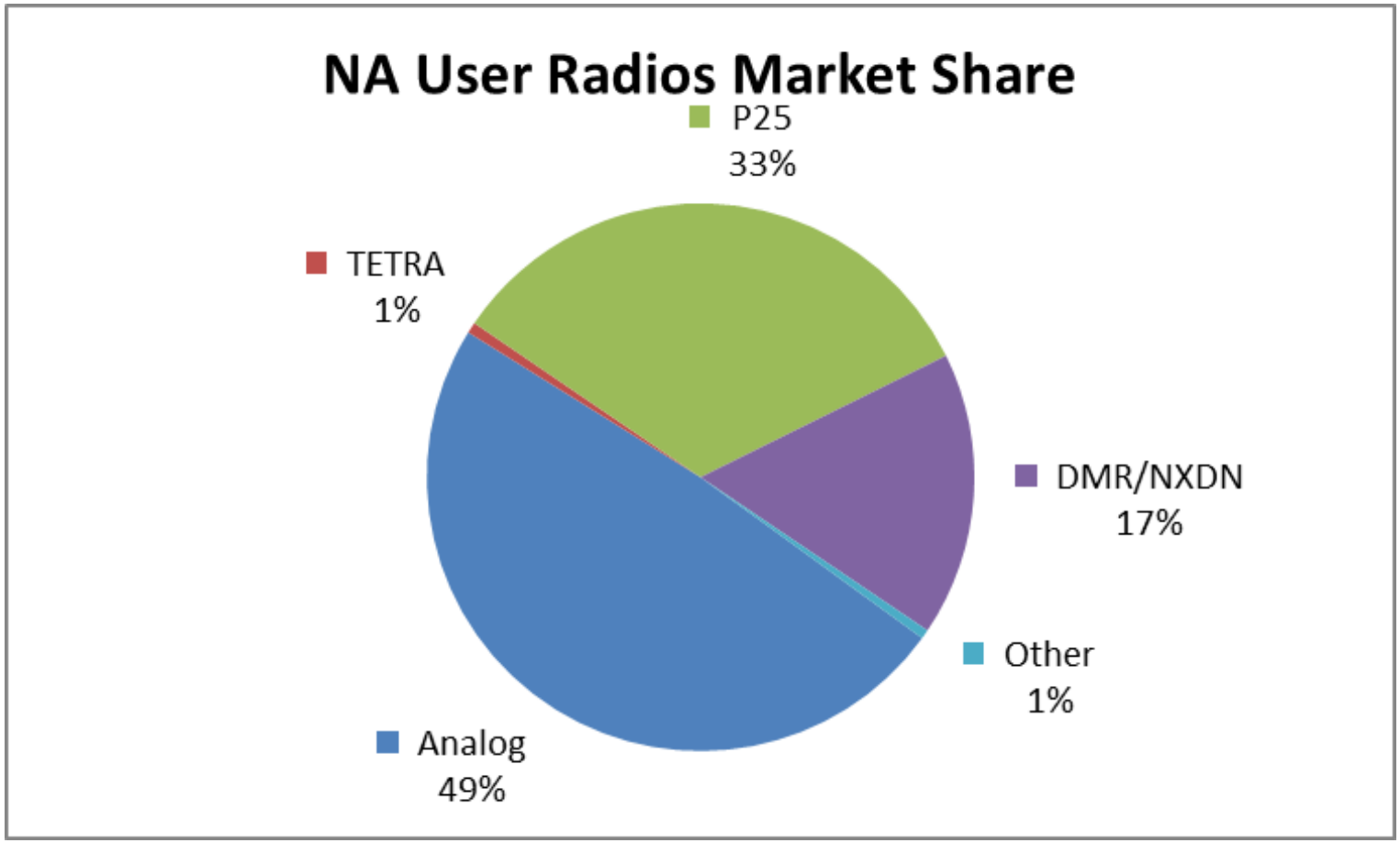
Type	RX Bandwidth	Noise Floor	$(C/N)_{req}$	Min. Signal Required
12.5 kHz FM	7.4 kHz	-125.8 dBm	26.0 dB	-99.8 dBm
25 kHz FM	17.9 kHz	-122.0 dBm	20.0 dB	-102.0 dBm
P25 (C4FM)	7.4 kHz	-125.8 dBm	17.7 dB	-108.1 dBm

P25 Adoption



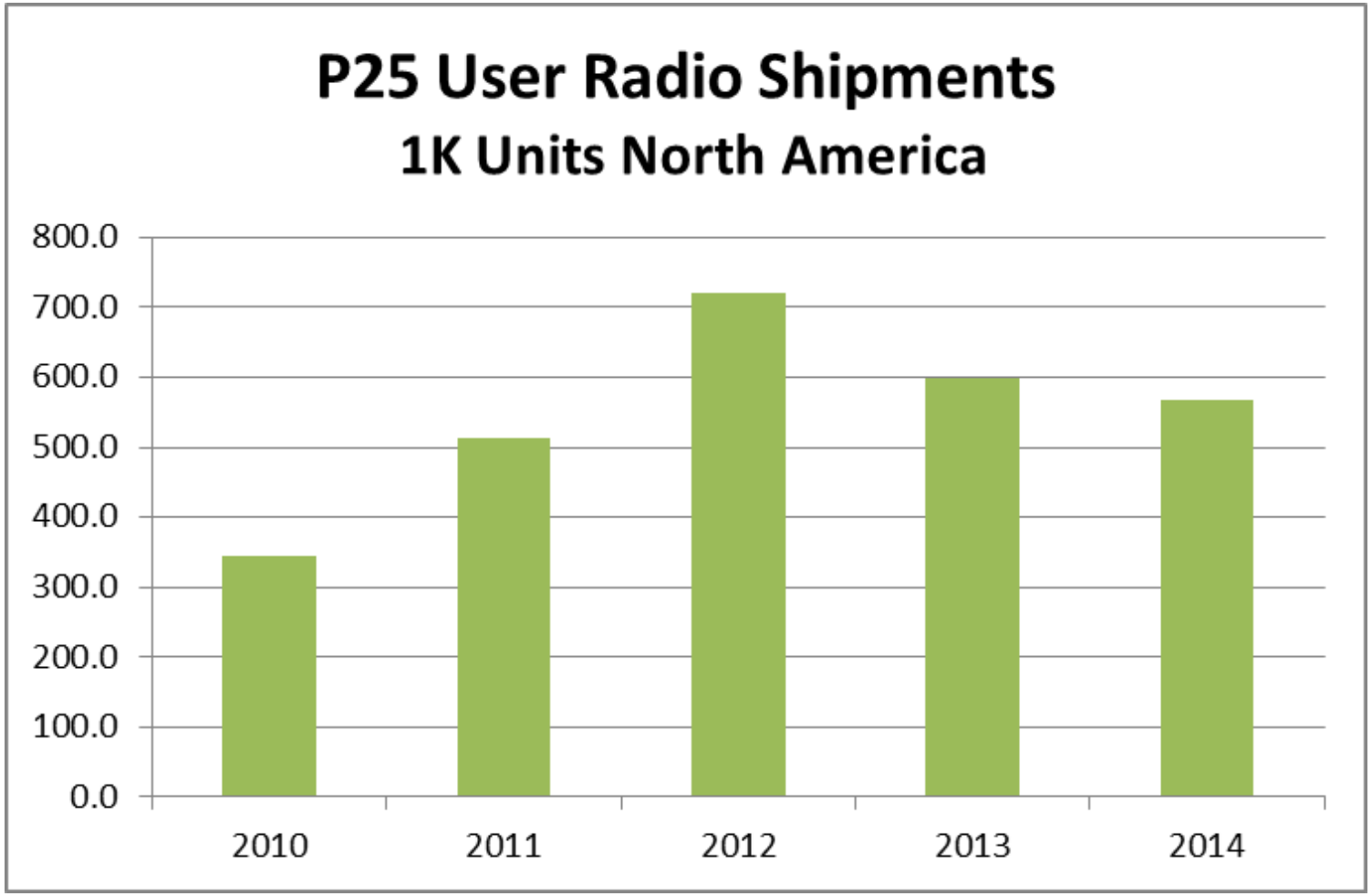
Data courtesy of TechNavio

Cumulative market share



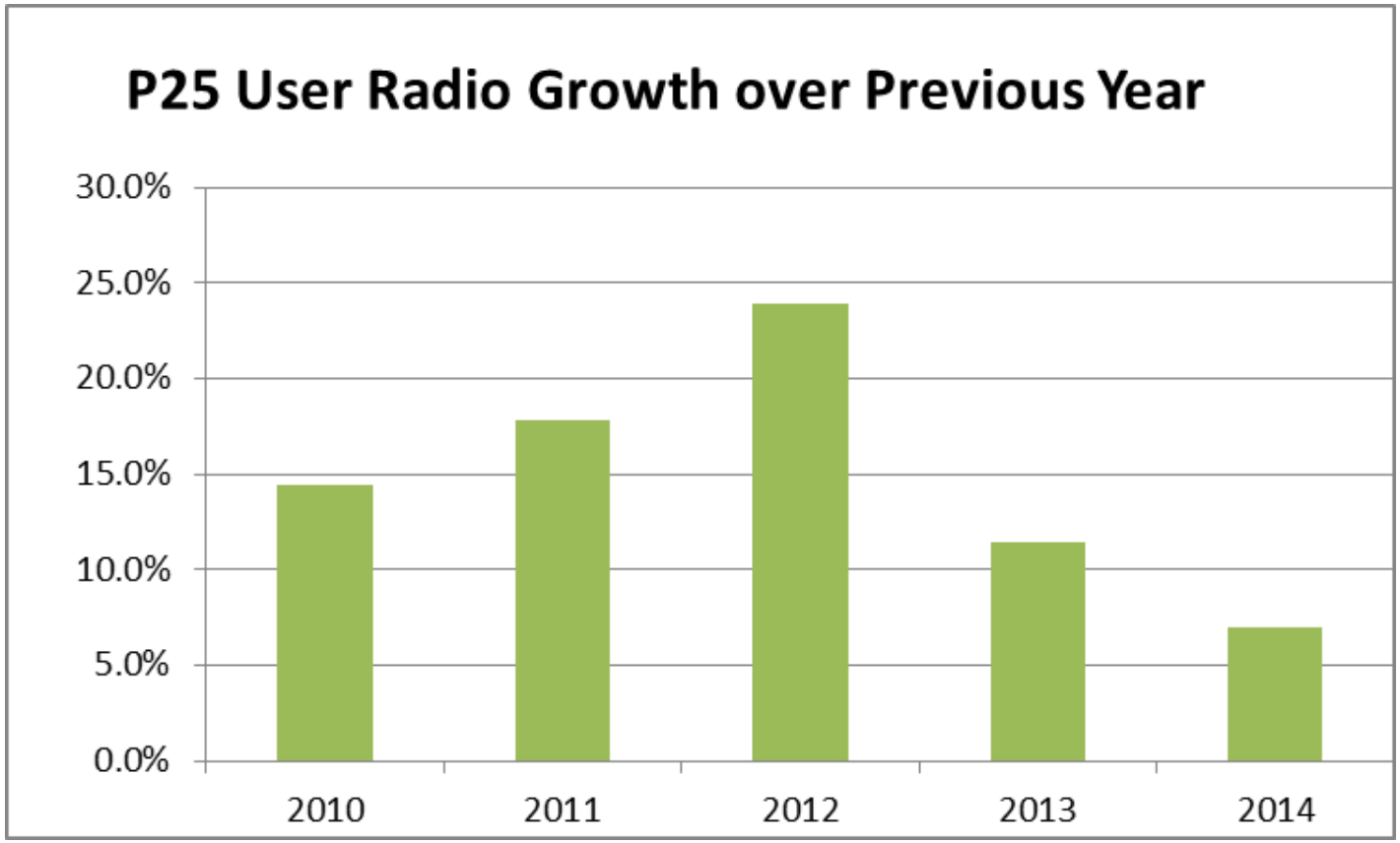
Source: IMS Research

Data for end-of-year 2012



Source: IMS Research

New and replacement each year – trunking and conventional

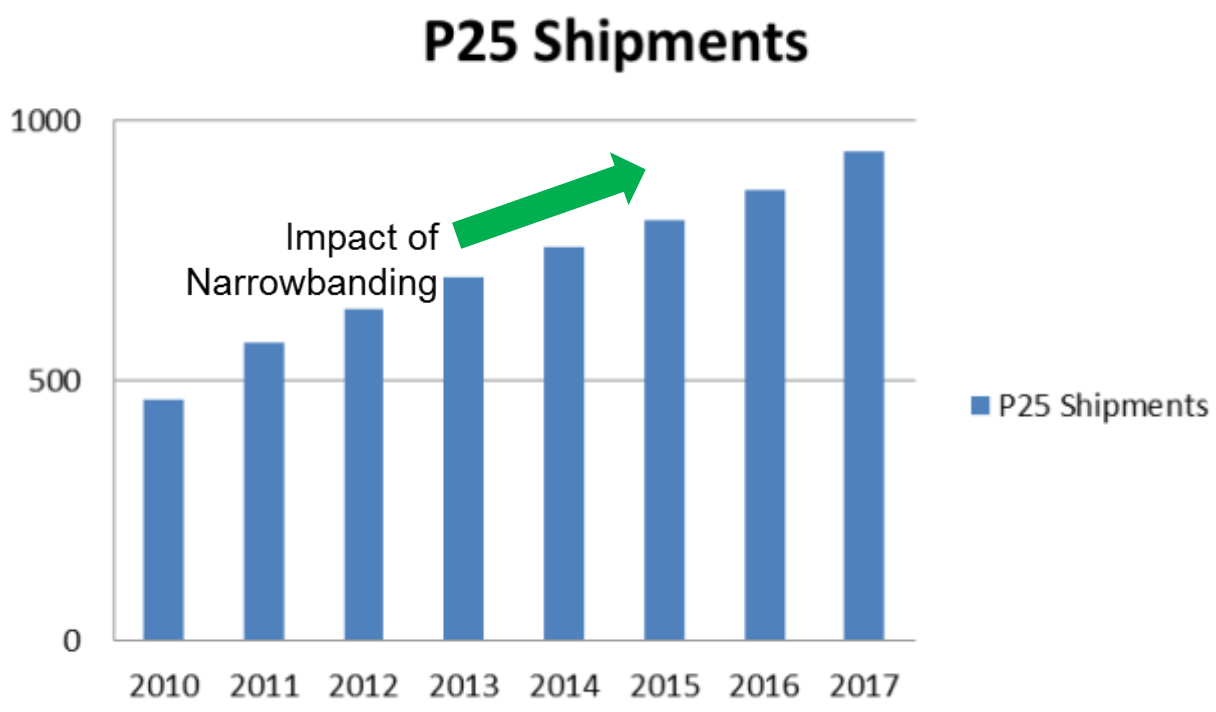


Installed Base of Active Radios - North America

Source: IMS Research

% growth (to prior year) in shipments for new and replacement radios for trunking and conventional

2013 & 2014 = the narrow banding “bubble” and impact of recession and reduction in tax revenues affecting purchasing of new P25.



Data Courtesy of: IHS Technology - Critical Communications Division

- Narrowbanding mandate of 2013 increased shipments out of NA.
- Funding out of the US.
- Long term success of P25 influenced by further 2017 mandate
- P25 Phase II projects being rolled out
- Mainly limited to PSS application area
- >60% of the global PMR P25 Market was in North America in 2012

- All States have multiple P25 V/U conventional systems
- Orange - city, county or multiple county P25 VHF or UHF trunked system.
- Green – (Plus Alaska) wide area or statewide VHF or UHF trunked system

700/800 MHz Systems

Every state except North Dakota, Maine, Vermont, New Hampshire and Alaska have 700/800 systems

Spectrum Efficiency

- Spectrum efficiency improved
  - 25 kHz to 12.5 kHz 2:1
  - 25 kHz to 6.25e 4:1
- Phase 2 = TDMA
- 6.25 KHz e
- V/U/700/800

P25 Another 25 Years?

- Continues to change and adapt
- A "Living Standard"
  - Regulatory
  - Technology
  - User needs
- Long term P25 influenced by current regulations (2017 mandate)
- 700 MHz Interop Channels mandate P25
- Agencies desire interoperability with V/U systems
- P25 Phase 2 projects being rolled out
- Mainly limited to PSS application area
- "Cell phone" technology won't meet needs (NPSTC).

Is Project 25 a Success?

- Initial principles and promises – *have they been met?* **Yes!**
- World wide penetration – *has it occurred?* **Yes!**
- Multiple vendors of products and services – *real choices?* **Yes!**
- Competition – *do they compete for your business?* **Yes!**
- Interoperability – *does it exist in meaningful tiers?* **Yes!**
- Scalable Solutions – *are they available to fit your needs?* **Yes!**
- Adoption rate in the U.S. – *P25 systems being deployed?* **Yes!**
- Future trends – *will deployments increase?* **Yes!**
- Range of support resources – *are they readily available?* **Yes!**
- P25 – *will it meet Public Safety needs another 25 years?* **Yes!**

Project 25

Technology Introduction and Overview

Andy Davis

Motorola Solutions

Project 25 Interfaces & Services

AIR INTERACES

P25 FDMA COMMON AIR INTERFACE

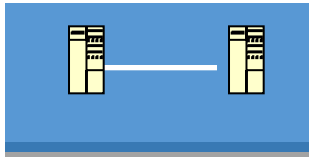
TRUNKING
Voice/Data

CONVENTIONAL
Voice/Data

P25 TDMA COMMON AIR INTERFACE

TRUNKING
Voice

WIRELINE INTERFACES



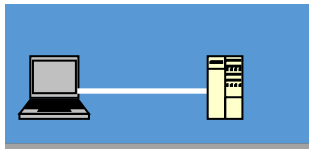
ISSI/CSSI

TRUNKING
Voice/Data/Control

CONVENTIONAL
Voice/Control

FSI

Conventional
Analog/Digital
Voice/Control



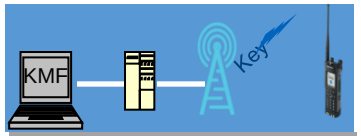
NETWORK MANAGEMENT

SECURITY INTERFACES

INTER- KMF

KEY FILL

SECURITY SERVICES



OTAR

TRUNKING/CONVENTIONAL

ENCRYPTION

Voice/Data

AUTHENTICATION

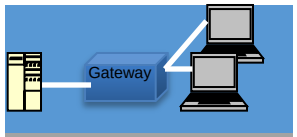
TRUNKING

DATA SERVICES

LOCATION

TIER 1
Conventional
TIER 2
Trunking/Conventional

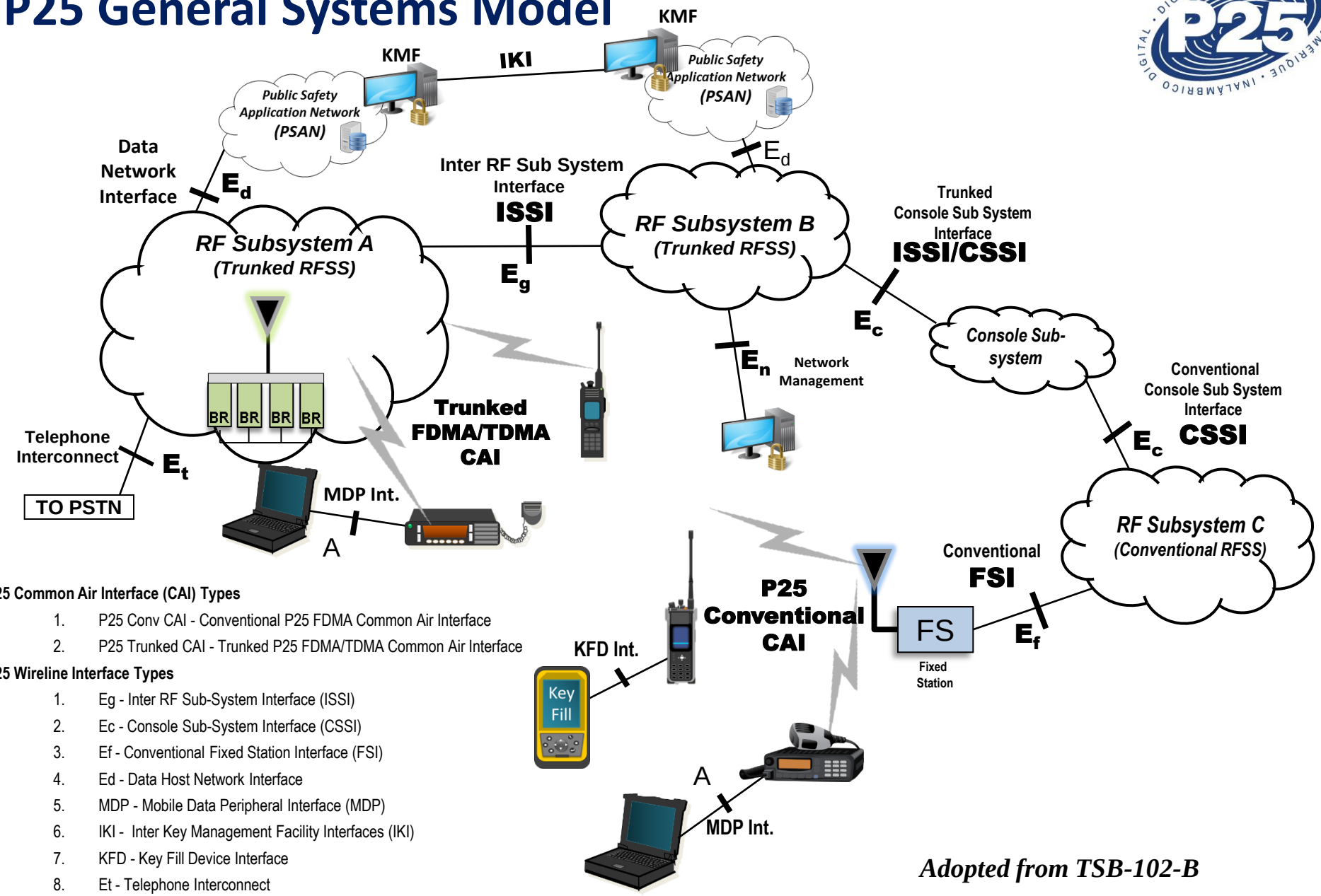
DATA INTERFACES



DATA NETWORK INTERFACE

SUBSCRIBER DATA PERIPHERAL INTERFACE

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

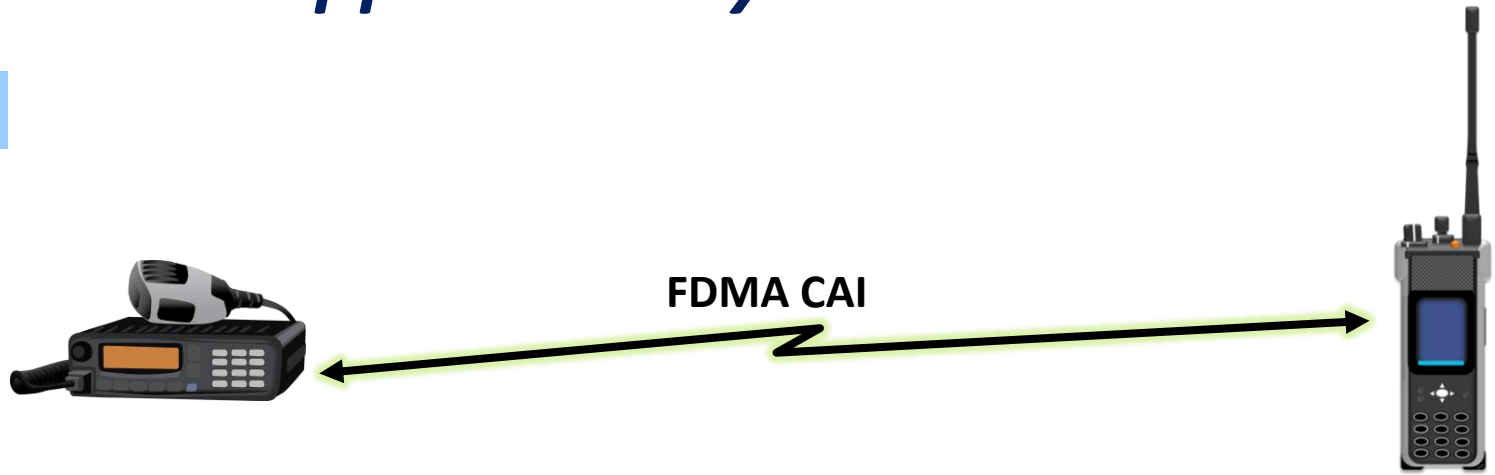
Standard Interfaces and Services

- **Configurations Using the FDMA Common Air Interface**
  - **Voice/Supplementary Services**
  - **Adding Data**
- **Configurations Using Wireline Interfaces**
  - **Fixed Station Interface**
  - **Conventional Console Subsystem Interface**

Conventional Configurations

Voice and Supplementary Services

Direct

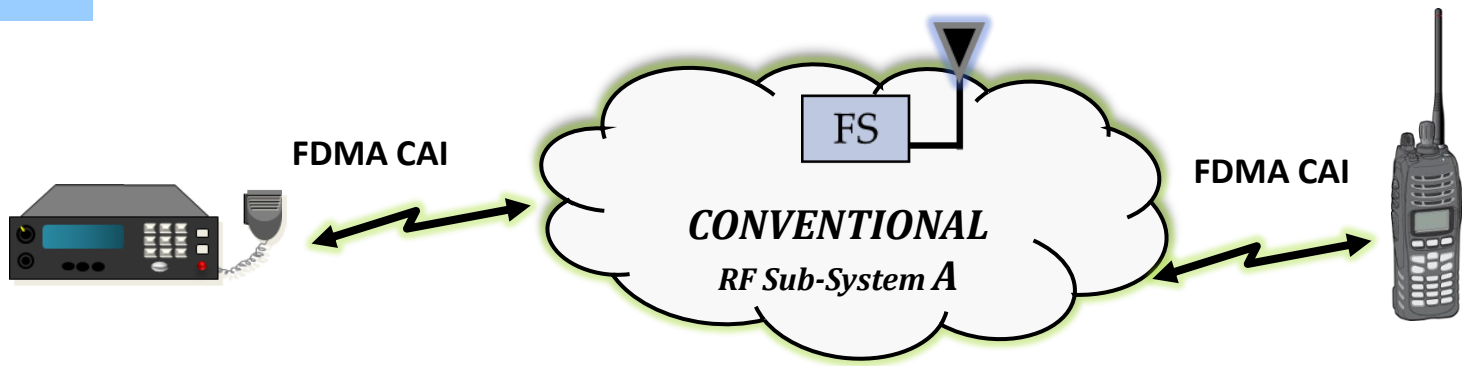


- **Conventional Voice services**
  - **Group Call, Individual Call, All Call, Talking Party ID, etc**
- **Conventional Supplementary Services**
  - **Emergency Alarm, Call Alert, Status/Message, etc**
- **Note: For a complete set of voice and supplementary services supported by the FDMA CAI for the 3 conventional configurations see section 2 of the PTIG Capability Guide**

Conventional Configurations

Voice and Supplementary Services

Repeated

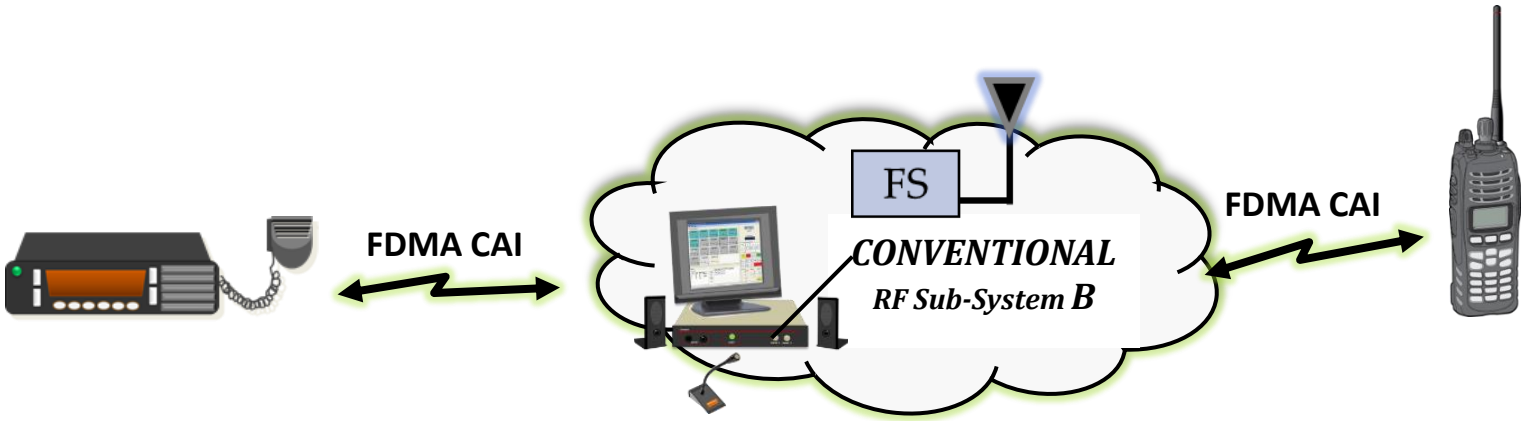


- **The RFSS is a virtual element**
- **RFSS may take on a variety of physical forms, i.e. there may be**
  - **multiple channels at a site or**
  - **multiple sites, or**
  - **channel may be a voting, multicast or simulcast "sub-system" covering multiple physical sites**

Conventional Configurations

Voice and Supplementary Services

Repeated with Wireline Dispatch

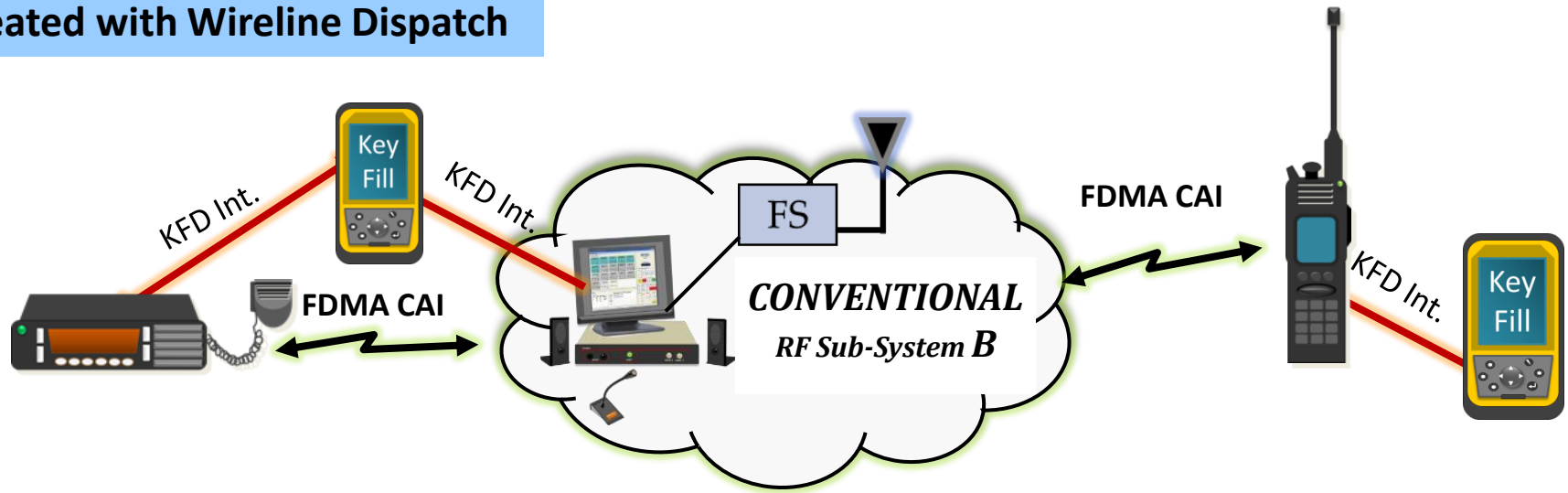


- **RFSS B may still repeat**
- **Console may participate in calls**
- **Console may be the source or target of calls**
- **Console equipment may interface to multiple stations**
- **Console equipment and station(s) within the RFSS do not need a standard P25 interface**

Conventional Configurations

Voice and Supplementary Services

Repeated with Wireline Dispatch

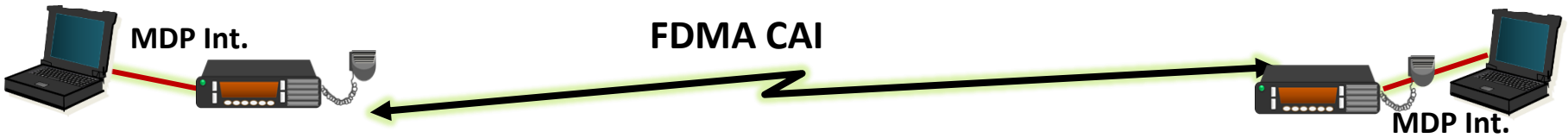


- Encryption service applies to all 3 conventional configurations
- Keys may be loaded from a Key Fill Device
- Key ID designated in the voice stream
- Transmit: Encryption keys may be selected per channel, per talkgroup or per conversation
- Receive: may use preselected encryption keys or may search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

Conventional Configurations

Adding Data

Direct

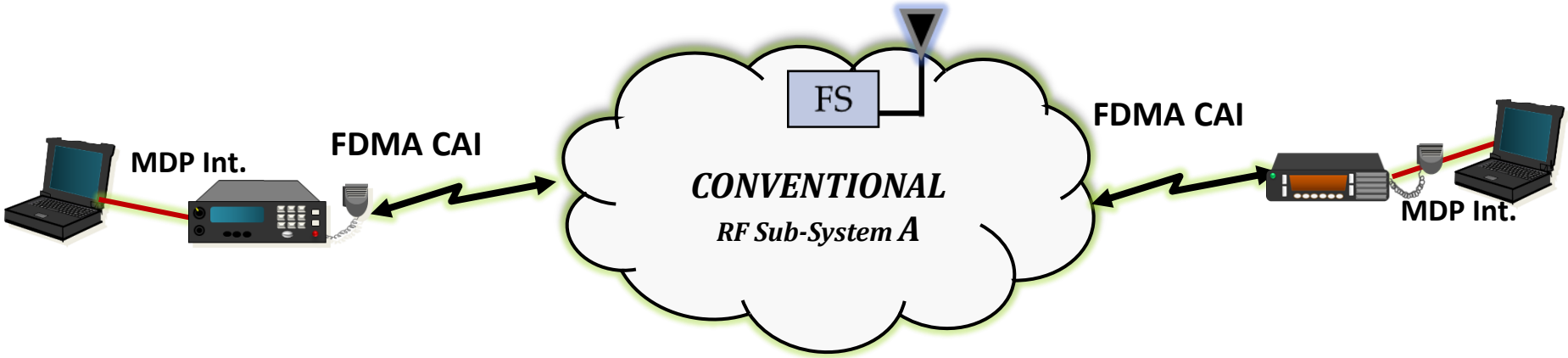


- **Data applications may reside in the radio itself**
- **The FDMA CAI protocol supports a data signaling protocol**
- **The CAI data packets may carry IPv4 datagrams**
- **IP Data Bearer service for data applications that use IPv4**
- **Note: For a complete set of CAI data bearer and IP data bearer services supported by the FDMA CAI for the Direct conventional configuration see sections 3 of the PTIG Capability Guide**

Conventional Configurations

Adding Data

Repeated

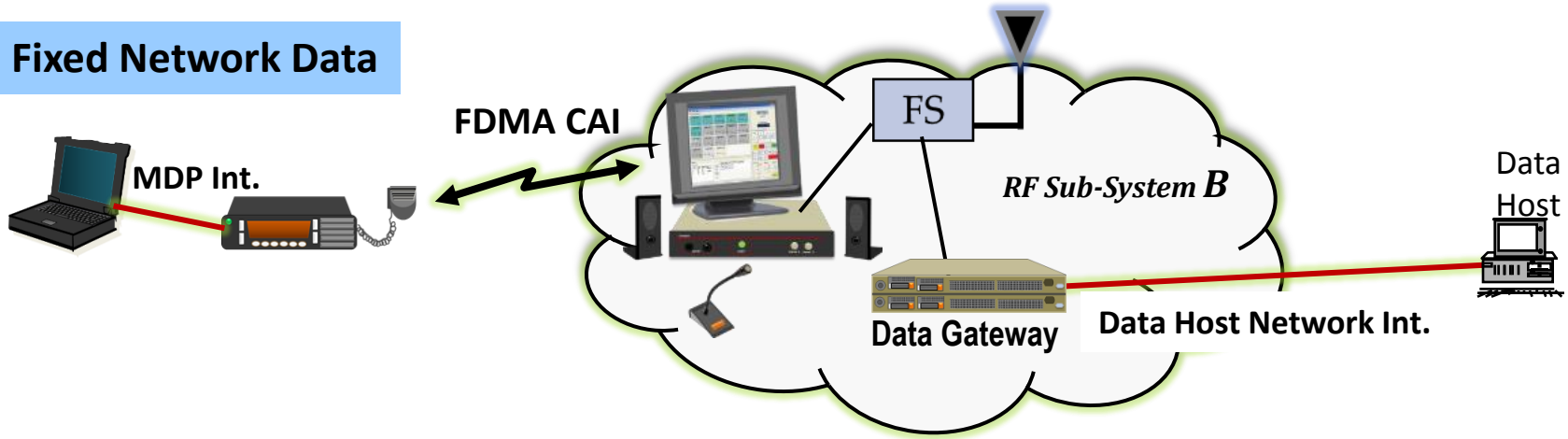


- **Fixed Station repeats the data signal**
- **Note: For a complete set of CAI data bearer and IP data bearer services supported by the FDMA CAI for the Repeated conventional configuration see sections 3 of the PTIG Capability Guide**

Conventional Configurations

Adding Data

Fixed Network Data

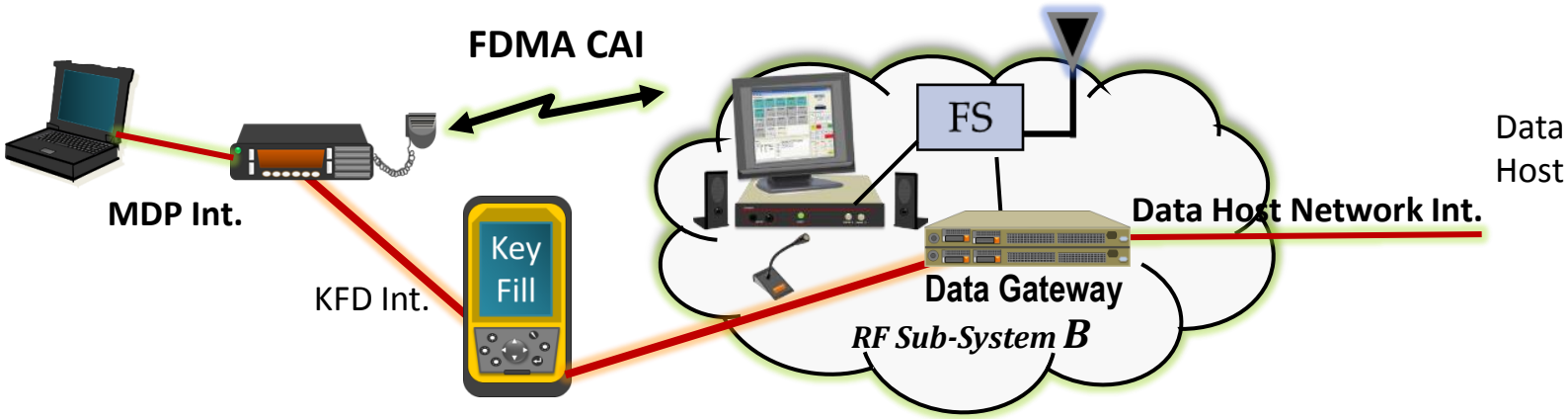


- **Fixed Station does not repeat the data signal**
- **Data Gateway device interfaces Data Host to Fixed Station**
  - **within the RFSS; does not need a P25 standard interface**
- **Data Host outside the RFSS: standard P25 Data Host Network Interface**
  - **carries IP datagrams**
- **Note: For a complete 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 Capability Guide**

Conventional Configurations

Adding Encrypted Data

Fixed Network Data

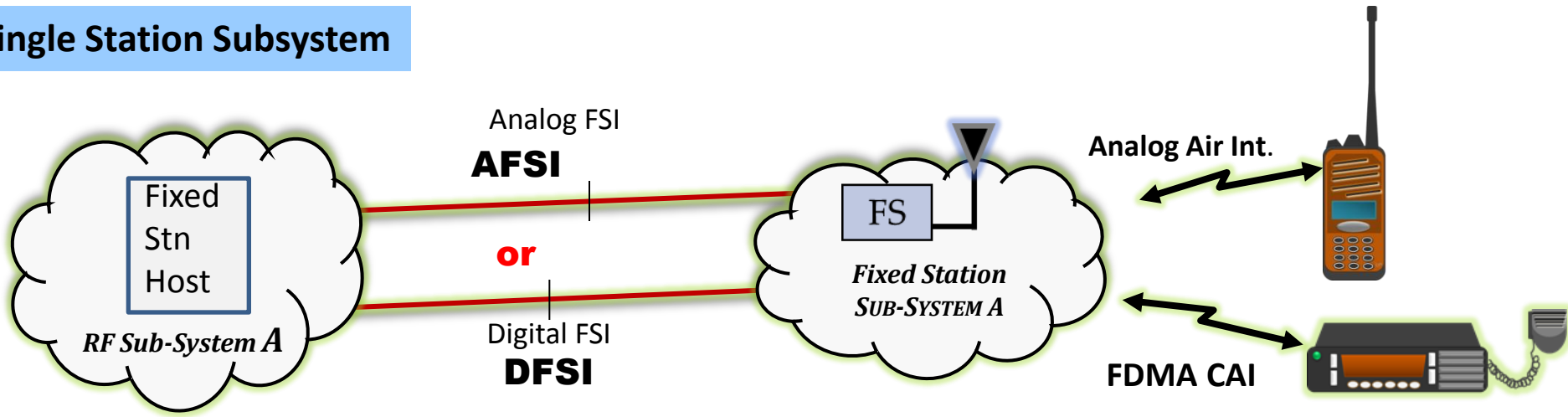


- **Encryption may be added to any of the 3 Conventional data configurations**
- **CAI data packet payload is encrypted**
- **Decryption required before the IP datagrams can be routed**
- **Encryption/decryption in radios and data gateway**

Conventional

FSI – Fixed Station Interface Configurations

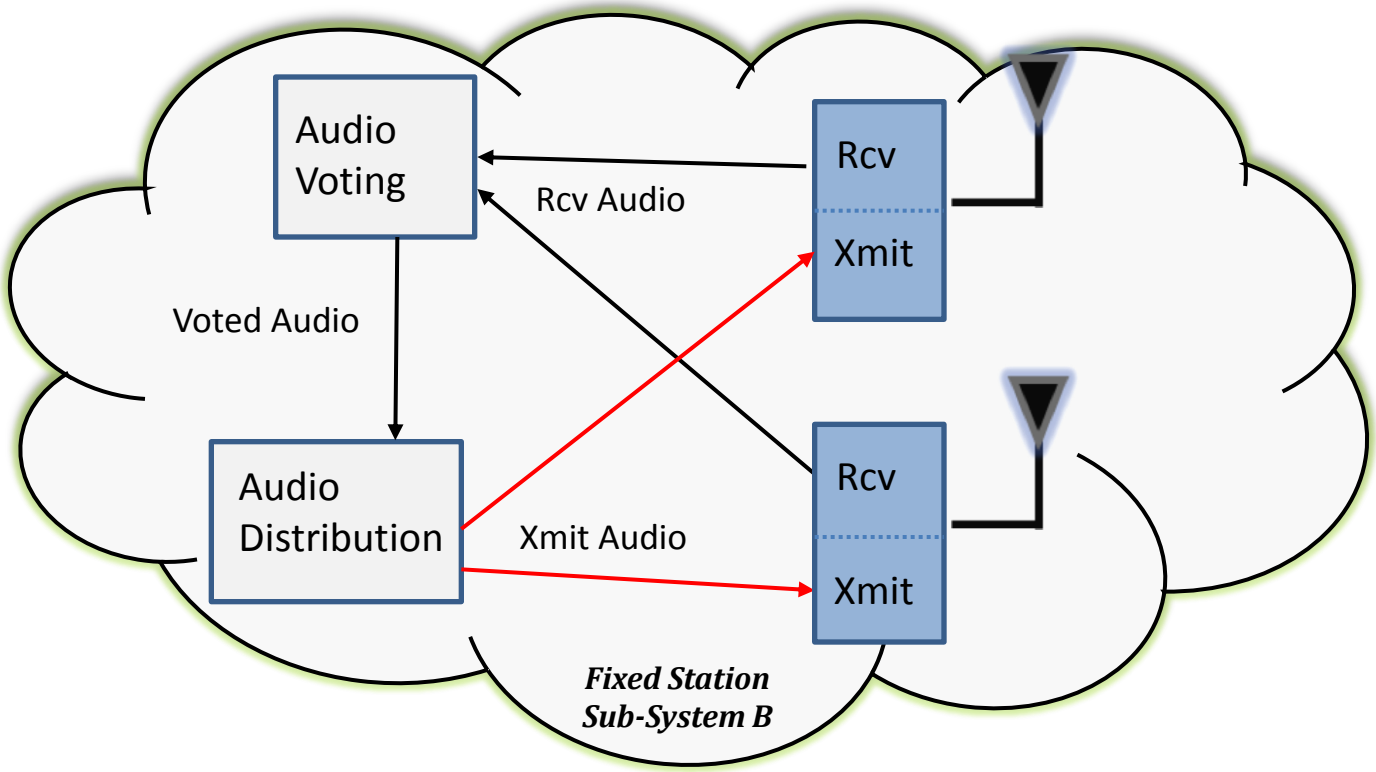
Single Station Subsystem



- **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

FSI – Fixed Station Interface Configurations

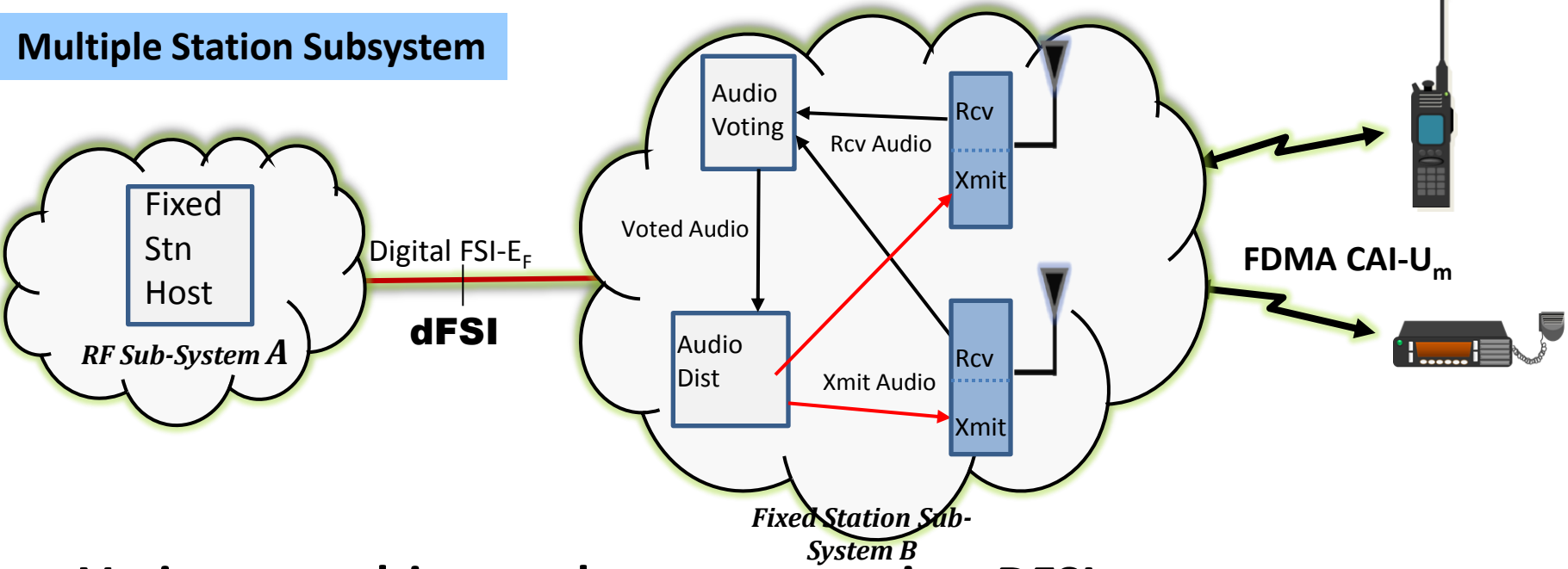


- **The Fixed Station Sub-System is a virtual entity that may take different physical forms**
  - **Single Station**
  - **Voting sub-system**
  - **Multicast sub-system**

Conventional

FSI – Fixed Station Interface Configurations

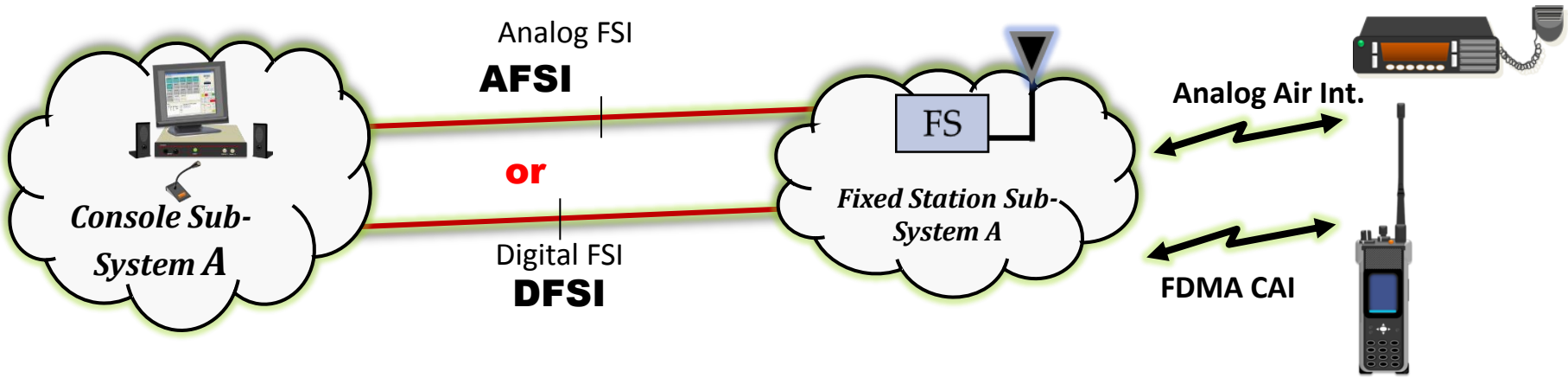
Multiple Station Subsystem



- **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: PTIG Capability Guide is currently being updated to include capabilities associated with these combinations of AFSI/DFSI and Analog/FDMA CAI air interfaces**

Conventional

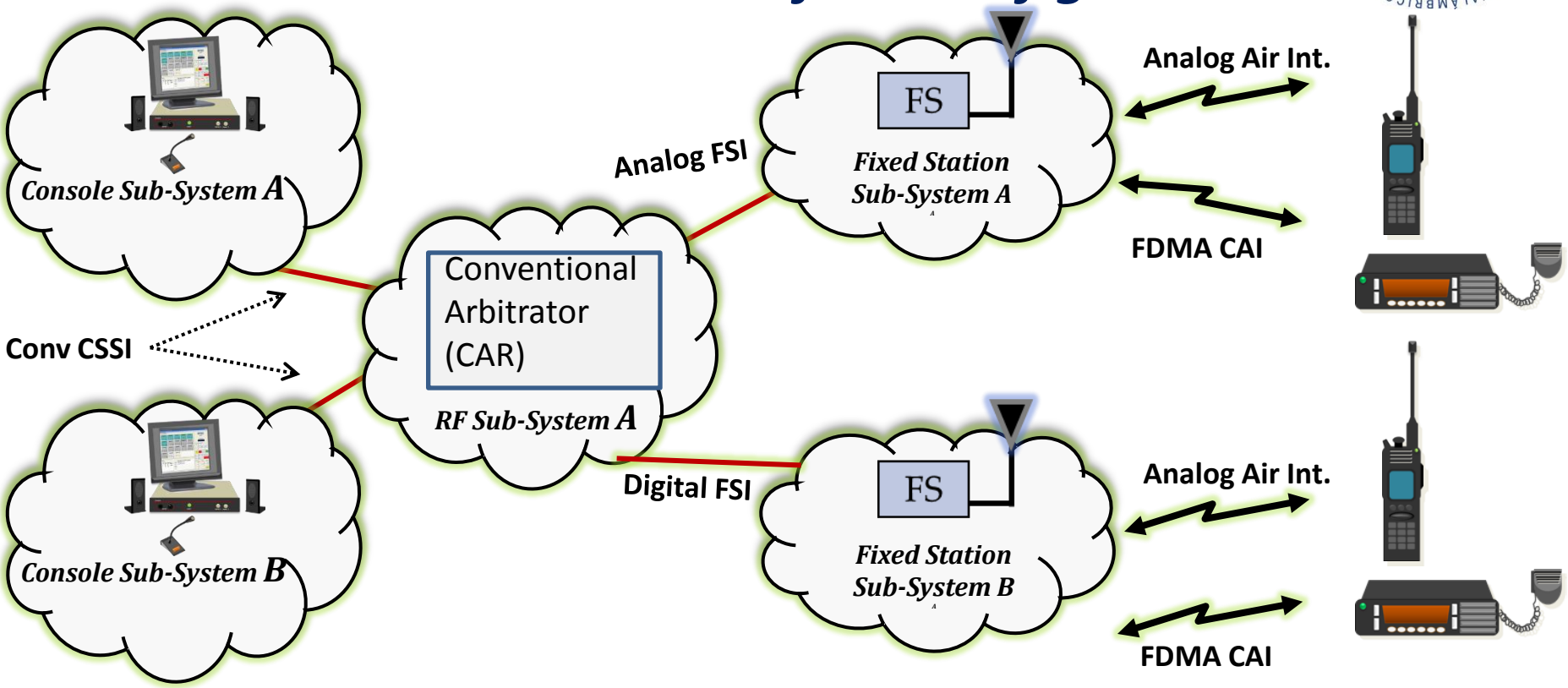
Console and Fixed Station Interface Configurations



- **FSI (AFSI or DFSI) may be used to connect the sub-systems directly when:**
  - **<u>Single</u> Console Sub-System and**
  - **<u>Single</u> fixed station or a <u>single</u> 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**

Project 25 Security Services Update

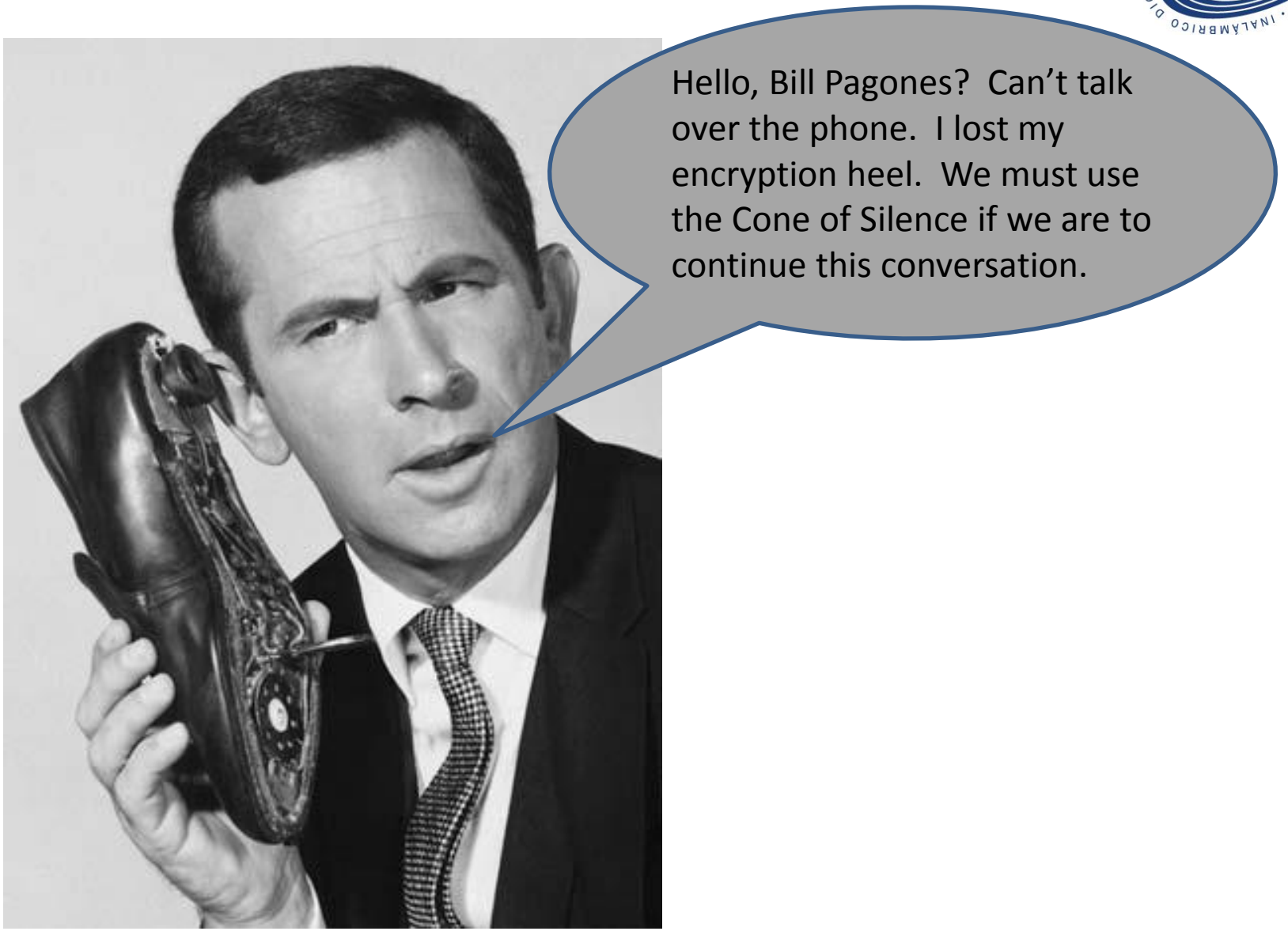
Bill Janky

Director, System Design

Harris Corporation

Agenda

- Overview of P25 Security Services
  - Confidentiality
  - Integrity
  - Key Management
- Current status of P25 security standards
  - Updates to existing services
  - New services


Hello, Bill Pagones? Can't talk over the phone. I lost my encryption heel. We must use the Cone of Silence if we are to continue this conversation.

Why do we need security?

- Information security is a vital component of LMR systems
  - Security threats exist; getting more every day
- What's a threat? Threats are actions that a hypothetical adversary might take to affect some aspect of an LMR system. Examples:
  - Message interception
  - Message replay
  - Spoofing
  - Misdirection
  - Jamming / Denial of Service
  - Traffic analysis
  - Subscriber duplication
  - Theft of service

What P25 has for you…

- The TIA-102 standard provides several standardized security services that have been adopted for implementation in P25 systems.
- These security services may be used to provide security of information transferred across FDMA or TDMA P25 radio systems.

Note: Most of the security services are optional and users must consider that when making procurements

The usual suspects…

- P25 provides
  - Confidentiality
    - Payload (i.e. voice and data) encryption
    - Link layer encryption
  - Integrity
    - User authentication
    - Message authentication
  - Key Management
    - Manual key loading and over-the-air rekeying

Message interception, traffic analysis

Message replay, spoofing, misdirection, denial of service, theft of service, subscriber duplication

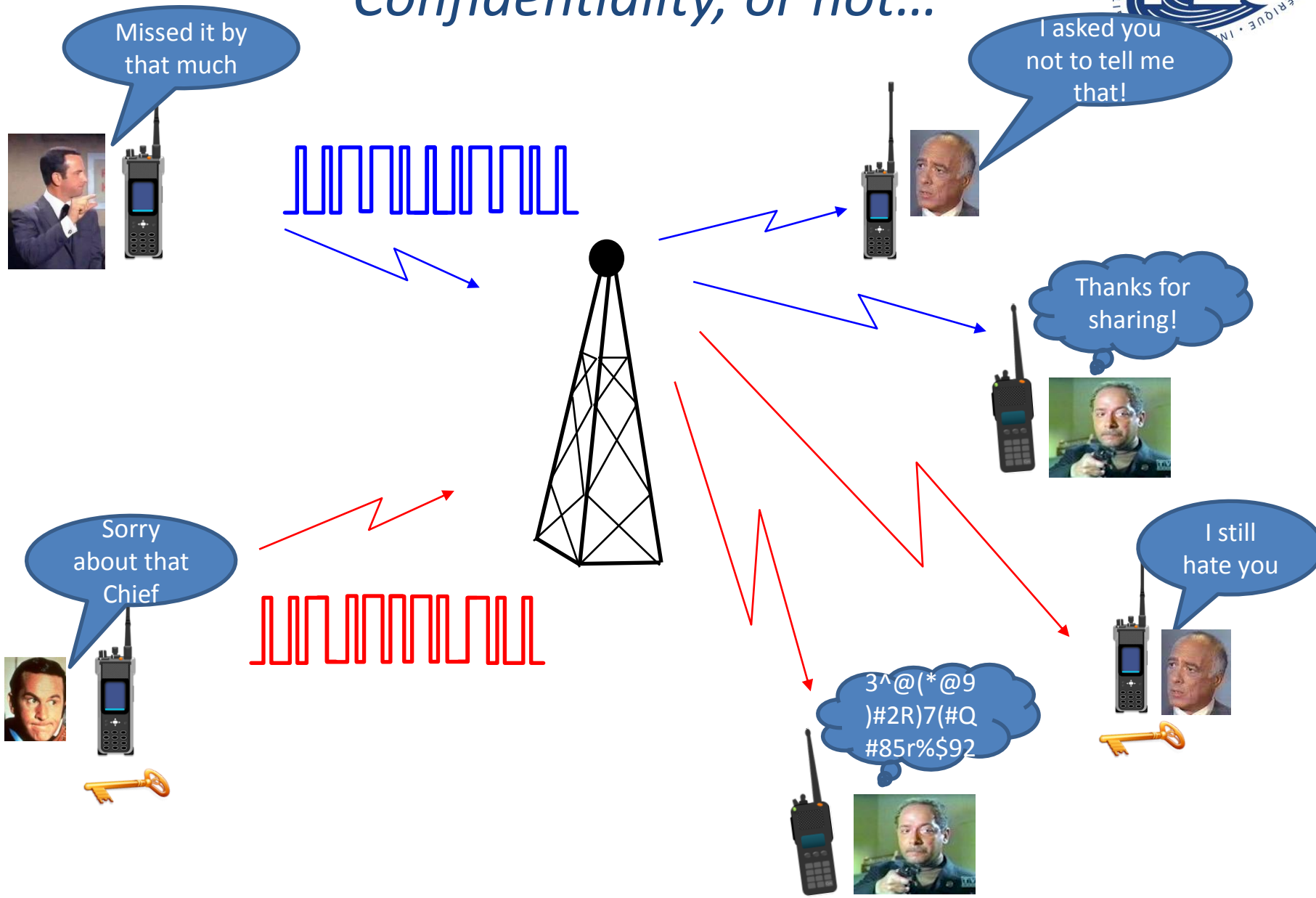
Facilitates Confidentiality and Integrity

Confidentiality

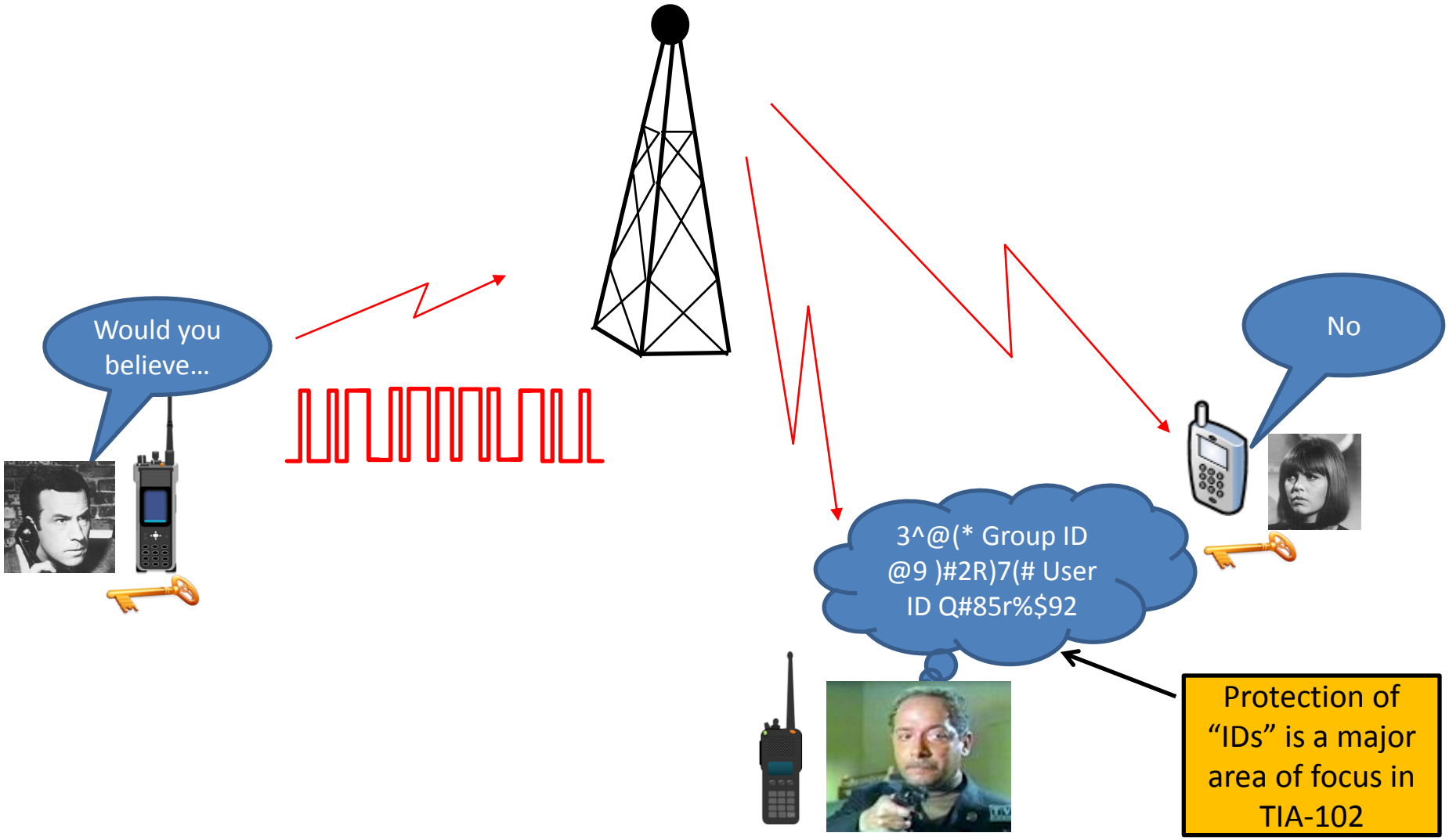
- The confidentiality services are provided to ensure that the signaling information, the voice traffic and the data traffic are understandable only to the intended recipient(s).
  - Encryption/decryption is the way to achieve confidentiality
- Confidentiality service for end-to-end encryption is typically done at the subscriber unit, console and data hosts.
- Confidentiality services are built into the P25 protocols.

If you don't want somebody to hear you, or see your data, you need to use encryption.

Confidentiality, or not…



One thing to note…



Integrity, or not

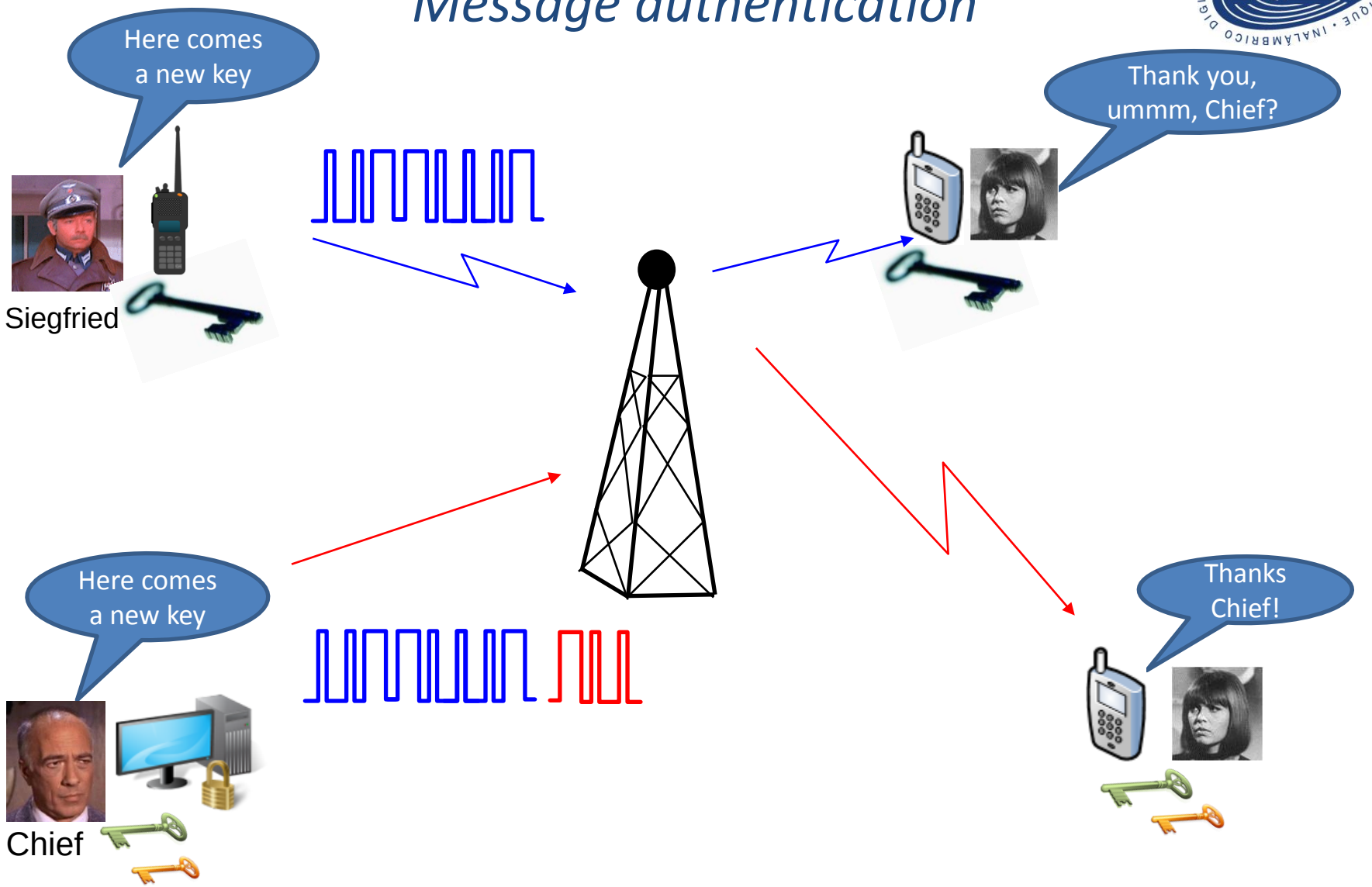
I'm not 100% sure I trust you…

Integrity

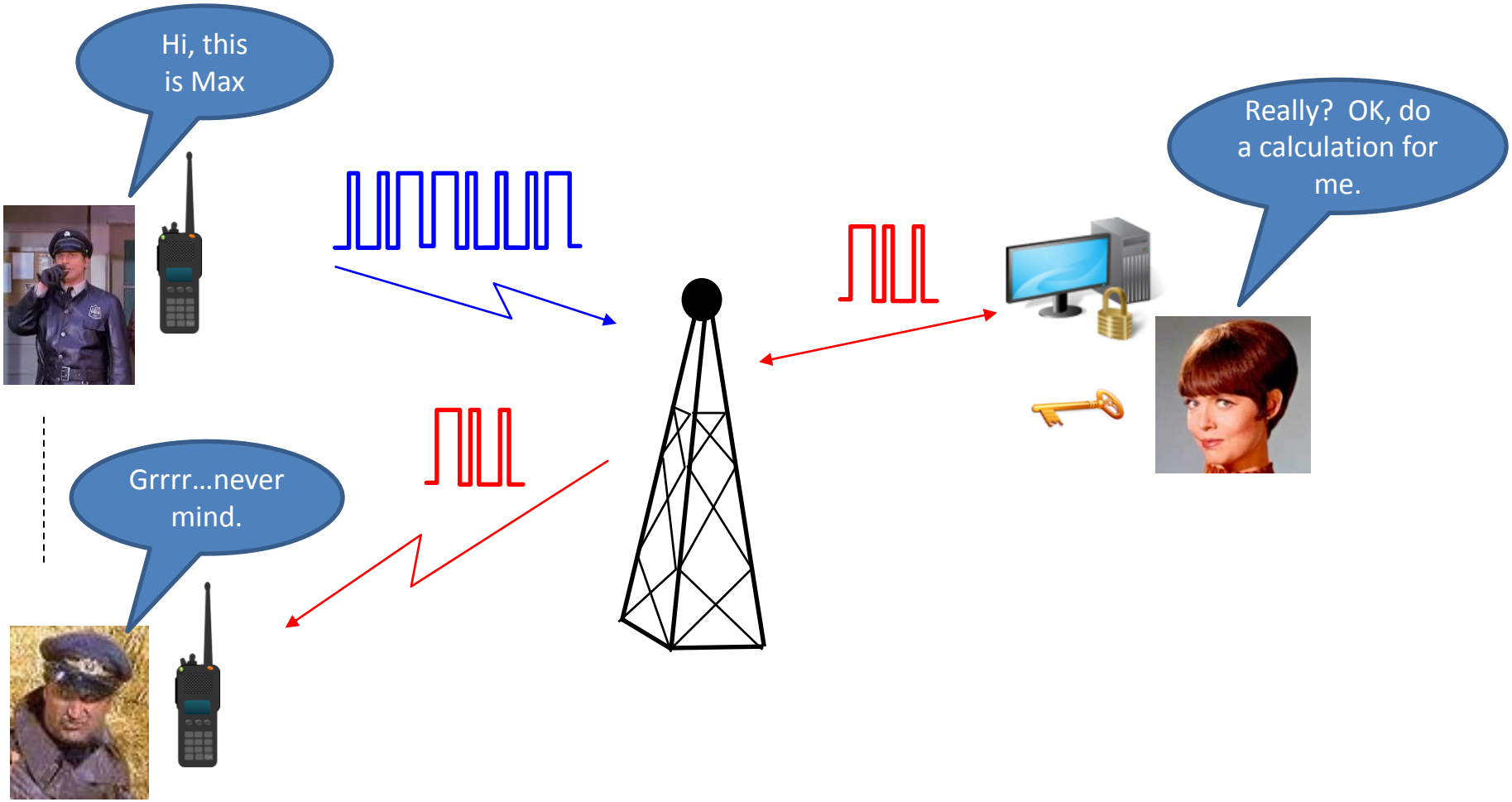
- Messages
  - A more sophisticated adversary may have the capability to not only record and replay messages, but to alter them as well. Message authentication guarantees that the received message was the one originally sent.
  - The addition of air interface encryption makes message modification more difficult (e.g. sharing of secret keys), but doesn't eliminate the possibility.
    - Message Authentication Codes (MAC) are required to guarantee message and sender integrity.
- Users
  - An adversary may "pose" as a real user or as a real system.
  - Link Layer (i.e. User) Authentication, LLA, guarantees that everybody is who they say they are.
- Integrity services are built into the P25 protocols.

If you don't want somebody to fake your data or your identity, you need authentication services.

Message authentication



User authentication



Key Management

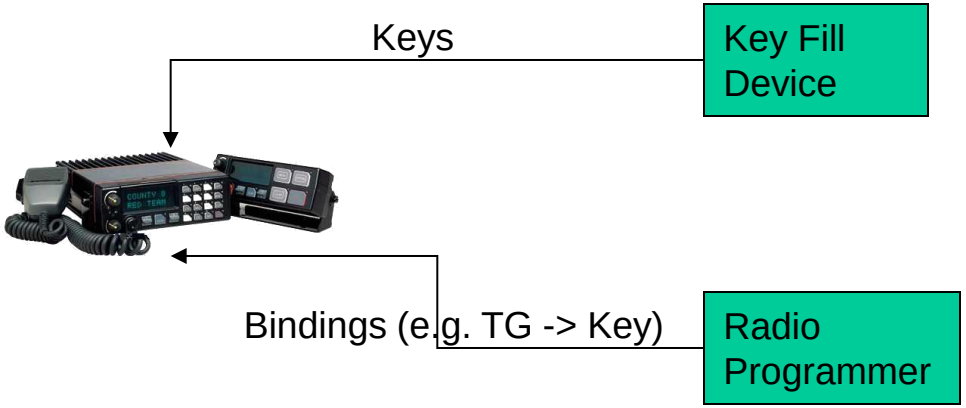
- The Confidentiality, Integrity and Authentication services rely on cryptographic keys.
- Cryptographic key management encompasses every stage in the life cycle of a cryptographic key, including:
  - generation, distribution, entry, use, storage, destruction and archiving
- P25 provides two ways to help manage keys – manual and OTAR.

Managing keys requires you to have some internal procedures to combine with P25 standard procedures.

P25 Key Management Techniques

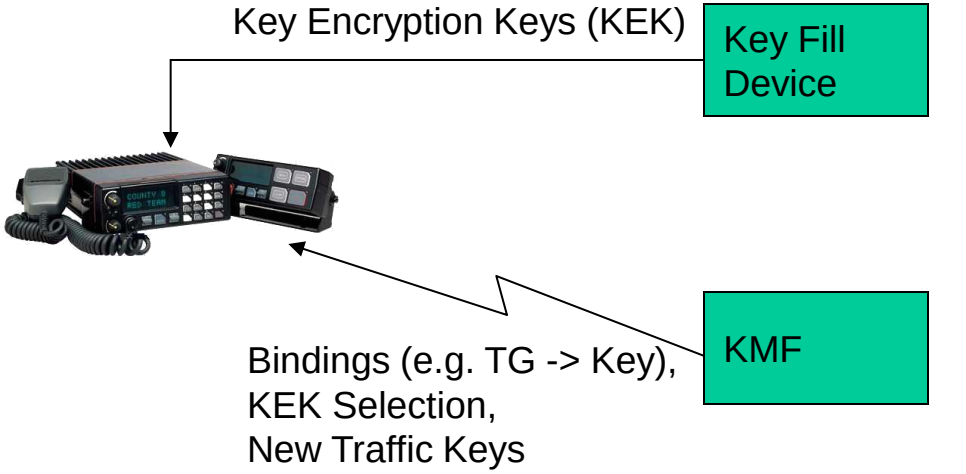
Manual Keying

- Radio “touched” to program Keys and key bindings.
- Compromised Radio Compromises Keys; requires rekeying of fleet



OTAR

- Radio “touched” for UKEK
- Rekeying can be performed over the air because each radio has its own UKEK.
- Key Management Facility (KMF) needs to be secure
- Message Authentication and Encryption Employed



P25 Security Status

Raising the Bar…

2011+
- End-to-End Voice Encryption
- Data CAI Encryption
- AES Encryption
- OTAR
- Multiple Keys
- Subscriber Validation
- Subscriber and FNE Authentication
- Inter-KMF Interface
- *KFD to SU/KMF/AF interface*
- *Link-Layer Encryption (Anti-Analysis)*

June 2005
- End-to-End Voice Encryption
- Data CAI Encryption
- DES Encryption
- 3DES Encryption
- AES Encryption
- OTAR
- Multiple Keys
- Subscriber Validation

Sept 1998
- End-to-End Voice Encryption
- Data CAI Encryption
- DES Encryption
- OTAR
- Multiple Keys
- Subscriber Validation

What's new, what's coming

- Update to P25 Key Fill Interface (TIA-102.AACD-A)
  - Revision and update of existing standard
  - Still in comment resolution, but coming soon….
- KMF to KMF Interface Specification (TIA-102.BAKA)
  - Published April 2012. Available on TIA Global IHS site.
- OTAR Messages and Procedures (TIA-102.AACA-A)
  - Major update that provides significant clarification to resolve many interoperability issues
  - All technical issues resolved; publication soon
- Packet Data end-to-end Security
  - On hold

What's new, what's coming (cont)

- Security Services Overview Addendum (TIA-102.AAAB-A-1)
  - Overview of the encryption and key management architectures for voice, data, subscriber authentication, and air interface encryption.
  - Draft document completed by APIC Encryption Task Group (ETG) was sent to TR-8.3 for final review and publication.
- KMF to KFD interface – New
  - Continuing steady progress, but still in comment review.
- Link Layer Encryption standard – New (…and loving it!)
  - LLE provides confidentiality and replay protection
    - Note: LLE is NOT a substitute for end-to-end encryption
  - Requirements reviewed and agreed to. LLE Architecture document is in review with agreements on many of the key architecture concepts.
  - Work plan has been formulated with preliminary assignments for drafting standards. Some existing standards will have to be updated for LLE, including the SSO.

Keep raising the bar and plugging new holes…

Summary

- If you don't want unauthorized people to hear you, or see your data, you need to use encryption
- If you don't want bad guys to fake your data or your identity, you need to use authentication services.
- Managing encryption and authentication keys requires you to have some internal procedures to combine with P25 standard procedures.
- The users and manufacturers participating in TIA-102 (P25) standardization are continuing to work to improve security services and add new features.
- System security factors affect mutual aid and interoperability. A sub-set of specific features can be defined as minimum required for mutual aid.

- **Finally**: Remember that most of the security, encryption, and voice protection features in P25 are optional, not mandatory, and users must consider that when making procurements
  - Encryption capabilities are not used by all, but are part of the features in the P25 Guide

Thank you!

email: william.janky@harris.com

Project 25 College of Technology Trunking Systems and Public Safety LTE Introduction

Cynthia Wenzel Cole

IWCE 2014, Las Vegas, Nevada
March 24, 2014

Presented by:

PTIG - The Project 25 Technology Interest Group

Project 25 Trunking

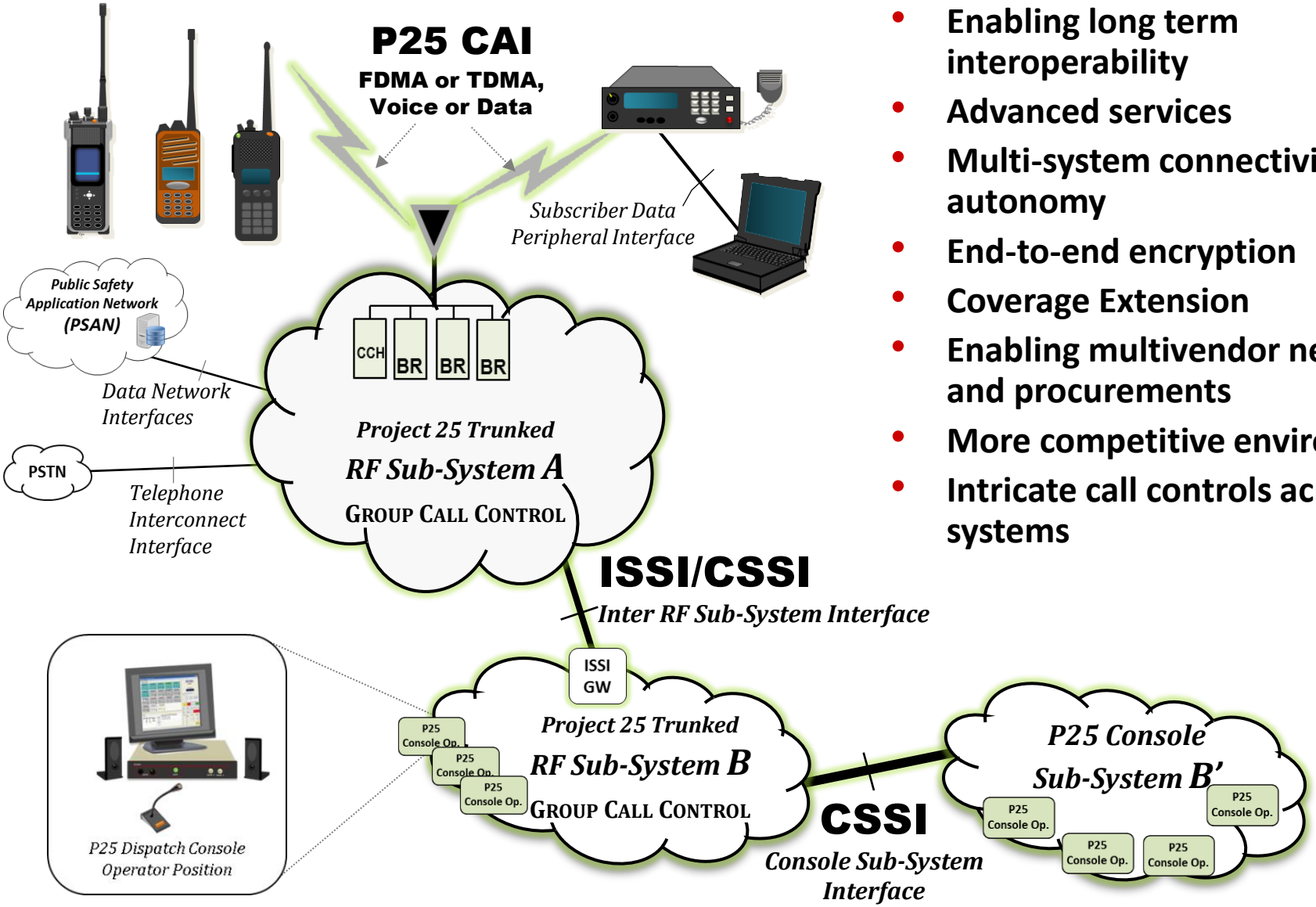
Agenda Topics

- **Introduction to P25 Trunking Interfaces**
  - **P25 Common Air Interface Overview**
  - **P25 Services & Single and Multi Site Configurations**
  - **Registration and Call Assignment**
  - **Adding P25 Packet Data Services**
- **P25 Wireline Interfaces**
  - **P25 ISSI/CSSI Introduction and Features**
  - **Architecture Overview**
- **Multi-System Configurations & Use Cases**
- **ISSI Case Study**

- **Introduction to NPSBN**

Primary P25 Trunking Interfaces

Introduction



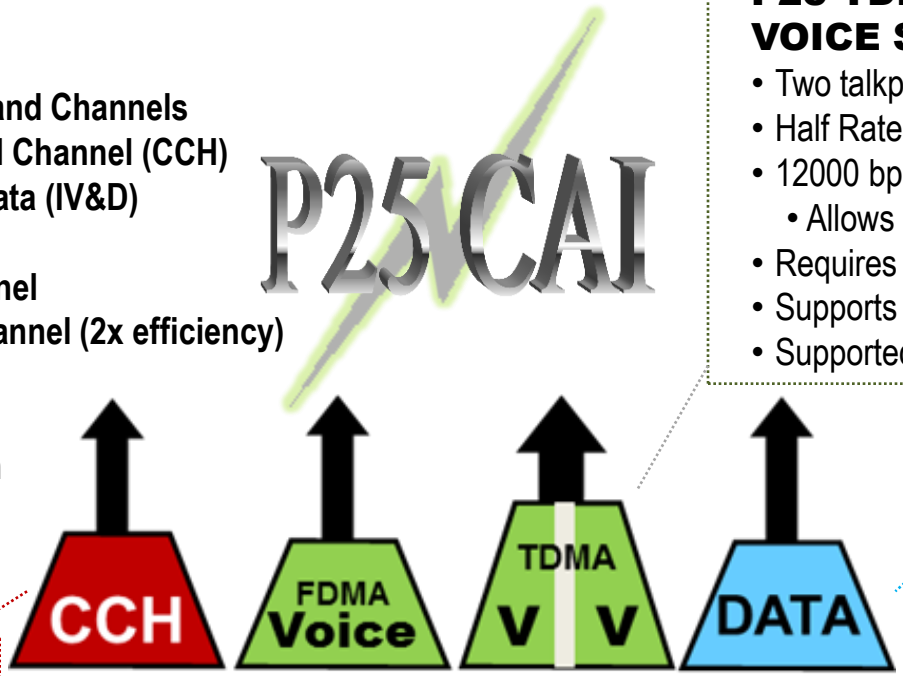
- Enabling long term interoperability
- Advanced services
- Multi-system connectivity with autonomy
- End-to-end encryption
- Coverage Extension
- Enabling multivendor networks and procurements
- More competitive environment
- Intricate call controls across systems

P25 Trunking

Project 25 Common Air Interface (P25 CAI)

P25 CAI Overview

- All operate on 12.5 kHz Narrowband Channels
- 9600 FDMA Interoperable Control Channel (CCH)
- Supports Integrated Voice and Data (IV&D)
- Traffic Channels
  - 9600 FDMA – 1 Talkpath/channel
  - 12000 TDMA – 2 Talkpaths/channel (2x efficiency)
  - DATA: 9600 FDMA
- Supports Simulcast
- Supports 256 bit AES Encryption



All operate on 12.5 kHz Narrowband Channels

P25 TDMA VOICE Services

- Two talkpaths per channel
- Half Rate AMBE
- 12000 bps OTA bit rate
  - Allows extra signaling
- Requires TDMA-capable subs
- Supports Encrypted Mode
- Supported across ISSI

P25 PACKET DATA Services

- 9600 bps OTA bit rate
- Supports Integrated Voice & Data (IVD)
- Backward compatible

Extended Control Channel

- Controls traffic on the network
- 9600 bps OTA bit rate
- Advertises unique WACN-SysID
- Assigns to FDMA, TDMA or DATA
- Backward compatible to all P25
- Extended version enables TDMA
- Supports Supplementary Services to FDMA & TDMA

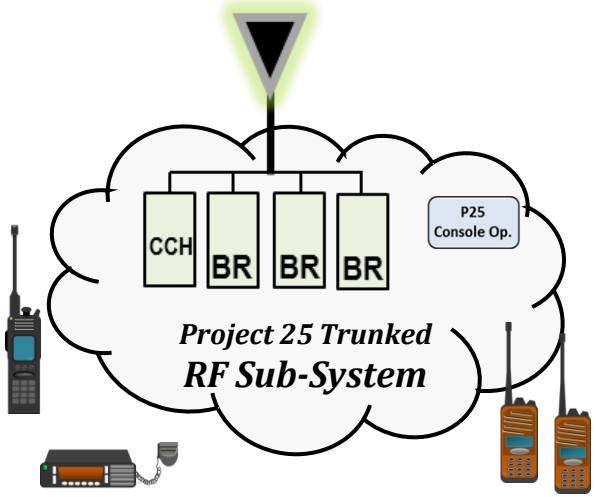
P25 FDMA VOICE Services

- One talkpath per channel
- 9600 bps OTA bit rate
- Full Rate IMBE or AMBE
- Backward compatible to all P25
- Supports Encrypted Mode

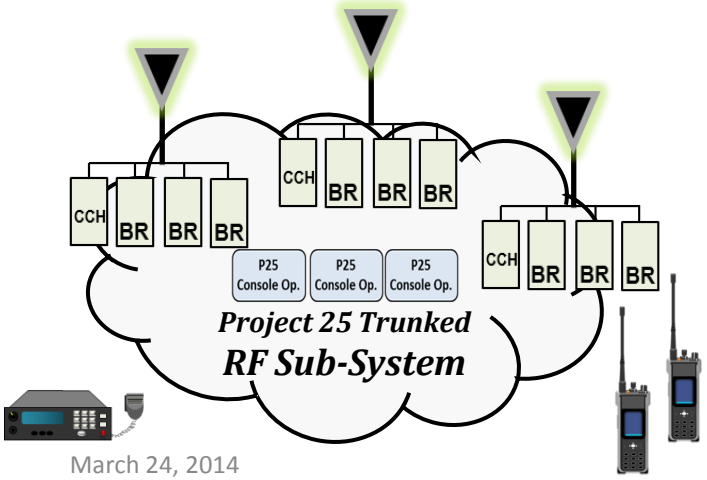
P25 Trunking

Basic Service & Configurations

Single Site Trunked RFSS



Multi-Site Trunked RFSS



- **Integrated Voice & Data Services**
- **Mobility & Registration**
- **End-to-End Voice & Data Encryption**
- **Supplementary Services**
  - **Radio Inhibit/Uninhibit**
  - **Call Alert**
  - **Emergency Alarm**
  - **Priority Call**
  - **Pre-emptive Priority**
  - **Radio Check**
  - **Discreet Listening**
  - **Radio Unit Monitoring**
  - **Short Message**
- **Telephone Interconnect**

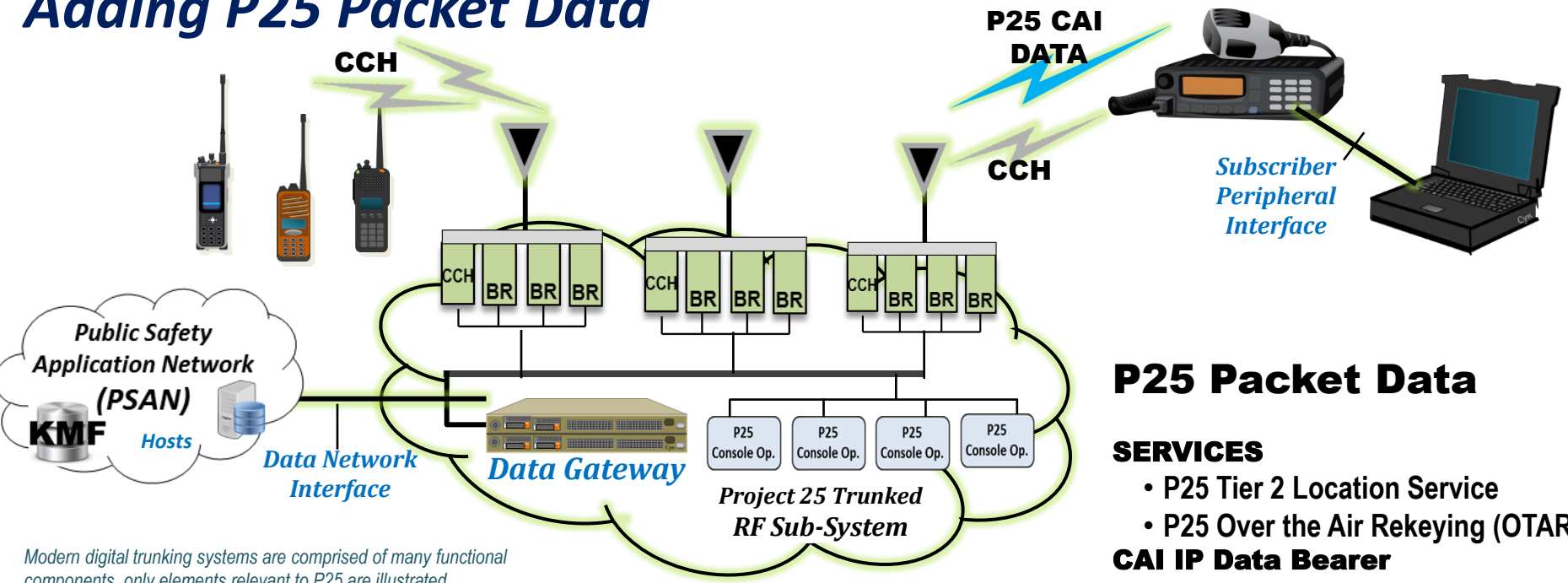
P25 Trunking

Registration and Call Assignment

- **Registration - When radios roam into or power up in coverage of a particular system they perform P25 full registration using their Home Individual ID (WACN + System + Unit ID) and provides following functions:**
  - **Registration identifies TDMA capability**
  - **An access authorization check usually occurs based on the P25 Unit ID**
  - **P25 Radio authentication or mutual (radio + system) authentication may be performed**
- **After successful registration, the radio performs P25 affiliation to the selected talkgroup using the full Home talkgroup ID (WACN + System + Group ID).**
  - **An access authorization check may occur and is based on talkgroup ID .**
  - **P25 ISSI/CSSI supports TG affiliation Home or Visiting radios and/or home or foreign talkgroups**
  - **When radios roam between sites, P25 mobility management services use P25 registration to track "Serving Sites" by Unit and TalkGroup IDs.**
- **When calls are assigned, call processing software ensures audio is routed between console equipment and sites serving the call participants.**

P25 Trunking

Adding P25 Packet Data



Modern digital trunking systems are comprised of many functional components, only elements relevant to P25 are illustrated.

- **The standard P25 Data Network Interface connects a data gateway device or functional element to the application Host(s) in the Public Safety Application Network (PSAN).**
  - **Trunking uses only the Fixed Network configuration.**
- **In trunking, data service requests on the control channel result in assignment of a data channel.**
  - **P25 Trunked FDMA Data channels may be assigned for single data transaction requests or a data channel may be assigned and then shared between multiple, independent data transactions.**

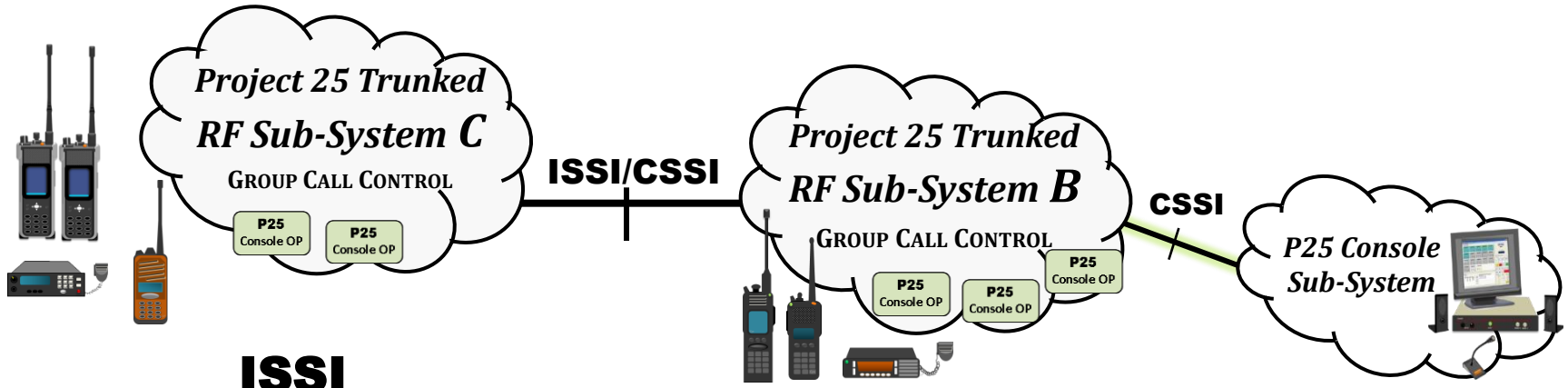
P25 Packet Data

SERVICES
- P25 Tier 2 Location Service
- P25 Over the Air Rekeying (OTAR)

CAI IP Data Bearer
- IPv4
- Confirmed
- Unconfirmed

Data CAI
- 9600 bps Integrated IVD
- 12.5 kHz Channel BW
- Supports Simulcast
- 256 bit AES Encryption

P25 Trunked ISSI/CSSI Overview



ISSI

Inter RF Sub-System Interface Features

- **Inter-System Group Call**
- **Emergency Group Call**
- **Emergency Alarm**
- **Transparent to AES**
- **Inter-System Unit-to-Unit Call**
- **Broadcast Call**
- **Status Query/Update**
- **Unit ID**
- **Call Alert**
- **Radio Inhibit**

CSSI

Console Sub-System Interface

P25 CSSI Adds to P25 ISSI Features:

- **Monitor Simultaneous TalkGroups**
- **Dispatcher Audio Takeover *(also called Console Priority)***
- **Console Take Over by Another Console**
- **Parallel Console Audio**

Which create console services, which are best described as:

- *Console-Initiated Group Call*
- *Radio-Initiated Group Call*
- *Console Priority*
- *Emergency Group Call*
- *Multiple TG Support*

Enabling

- Communications and control between P25 systems & supporting consoles
- Interoperability across vendor solutions
- Interoperability option with neighboring networks, regardless of how they evolve and change
- Connectivity while maintaining system autonomy
- Support of mixed vendor backbones
- End-to-end encryption

P25 ISSI/CSSI

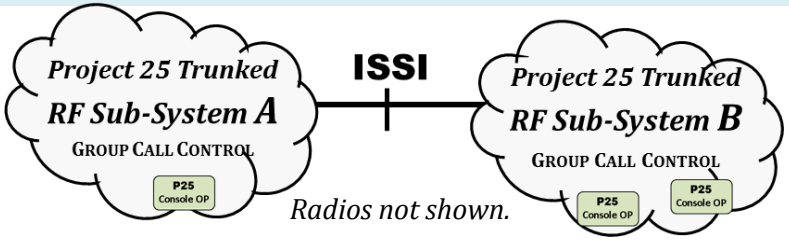
Architecture Overview

- **Each P25 RFSS and P25 console subsystem is identified by a unique WACN ID + System ID + RFSS ID.**
- **The P25 ISSI/CSSI may be used to connect any combination of WACN IDs, System IDs and RFSS IDs**
- **The ISSI architecture is based on the concept of a "Home" and a "Serving" RFSS:**
  - **The "home" RFSS represents the home based location and radio coverage area under which a particular talk group and/or individual operates.**
  - **A "serving" RFSS represents a foreign location and radio coverage area to which a talk group (or certain members of a talk group) and/or individual has roamed, and is away from the home-based radio coverage area**
- **ISSI TIA 102.BACA-A Messages & Procedures**
  - **ISSI Messages and Procedures defines the basic ISSI protocol for trunked voice and mobility management operations**
  - **Based on SIP for session/call setup, control, and teardown**
  - **Uses RTP for transmission of P25 IMBE voice packets and PTT floor control**

P25 ISSI & CSSI

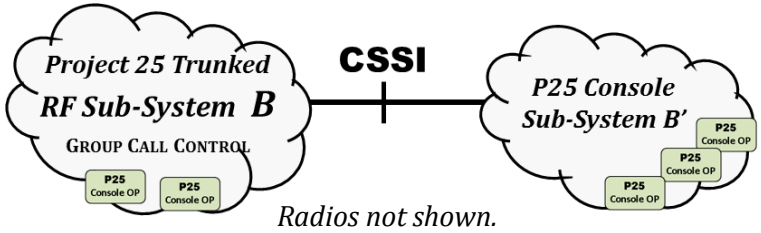
Multi-System Use Cases

Connecting RF Sub-Systems Using ISSI (no CSSI)



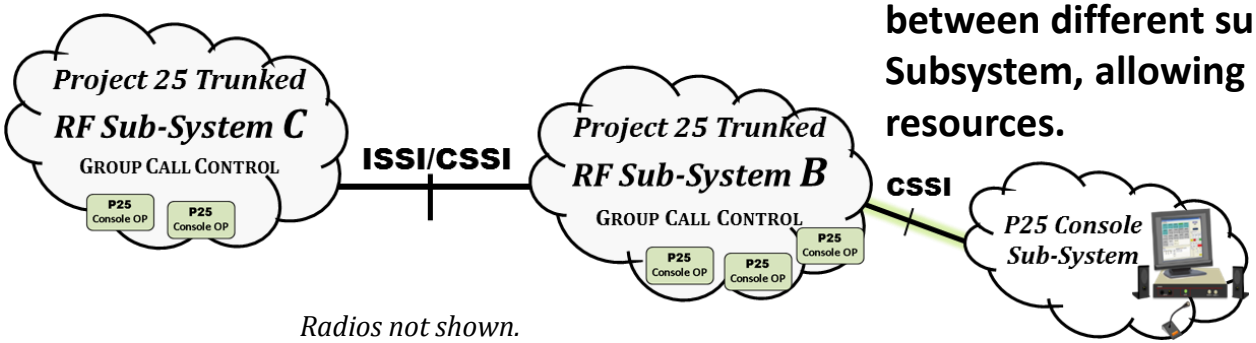
- Creates interoperable P25 Services across disparate systems
- Console operate across ISSI but without CSSI features;
  - Consoles behave like subscribers.

Connecting Systems Using CSSI Only



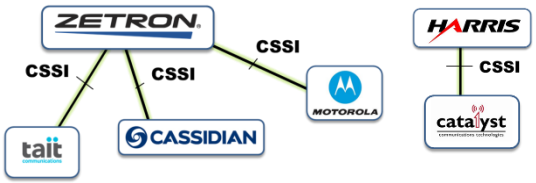
- CSSI can be used to connect a separate Console Sub-system B, allowing console operator (Console OP) positions to control traffic on System B
  - Enables 3rd party P25 console options
- Consoles can operate on both sides of interface

Connecting Systems Using ISSI/CSSI



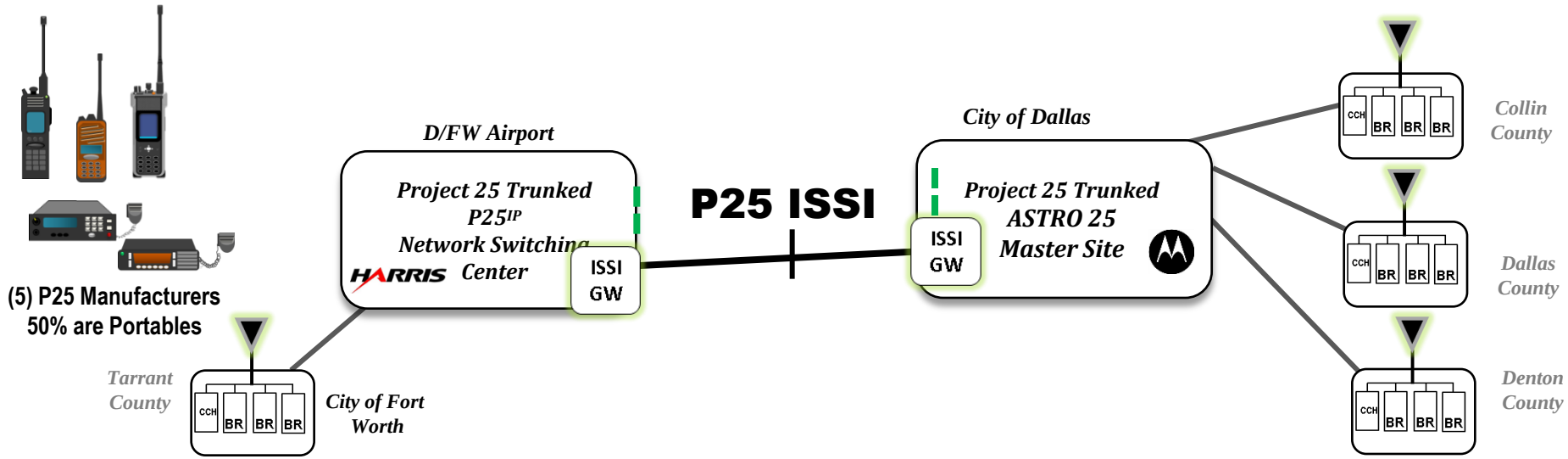
- This configuration supports all P25 ISSI/CSSI features between different subsystems and a separate Console Subsystem, allowing intricate controls over vast network resources.

IWCE 2013 DEMO (Examples)



P25 ISSI Case Study

CONNCT Overlay System Case Study



CONNCT

Communications Overlay for North Central Texas

SYSTEM

- 4-County Mobile Coverage
- 700 MHz only
- (2) Subsystems connected via ISSI
- T1 Backhaul
- (4) 3-Channel multicast

SERVICES

- (4) Regional TGs over ISSI
- (6) Agency-specific Encrypted ISSI TGs
- Unit ID configuration

Users

- 6.5M Residents
- 14000 Active Unit IDs
- 100 Agencies
- 3000-6000 Active Interop Users

- **The system uses two trunked RFSSs with different System and WACN IDs connected over a P25 ISSI**
- **ISSI has been rock solid through over 3 years of operation**
- **Federal LE (DEA) use dedicated, encrypted talkgroups across the region which have enormous operational value.**
  - **Wide area Radio Inhibit, has been particularly powerful for them, saving them time, energy and money.**
- **Challenges include: governance, portable coverage, funding, regional planning, end user training, O&M and Unit ID coordination across multiple systems**
  - **CONNCT implemented ID coordination which creates a unique "P25 Radio Unit ID" which is unique to the device across the State of Texas**

Nationwide Public Safety Broadband Network (NPSBN) – Introduction

- The NPSBN is defined as a single, nationwide Public Safety LTE (PS LTE) network
- LTE is based upon the global 3GPP standard
- FirstNet is the authority created by Congress to govern, construct and manage the FirstNet Network (FNN)
- FirstNet pledges to build the FNN to meet the needs of Public Safety users
- Congress[1] allocated $7B in funding and $121M for State grant program (SLIGP)
  - Will be a self-sustaining, fee-based network which will leverage tribal, state and local government assets
- FirstNet was allocated 20MHz of spectrum nationwide in the 700MHz band.
  - FirstNet is the nationwide FCC License holder

[1] *Middle Class Tax Relief and Job Creation Act of 2012*.

Thank You!

These powerful interfaces are deployed into real products today.

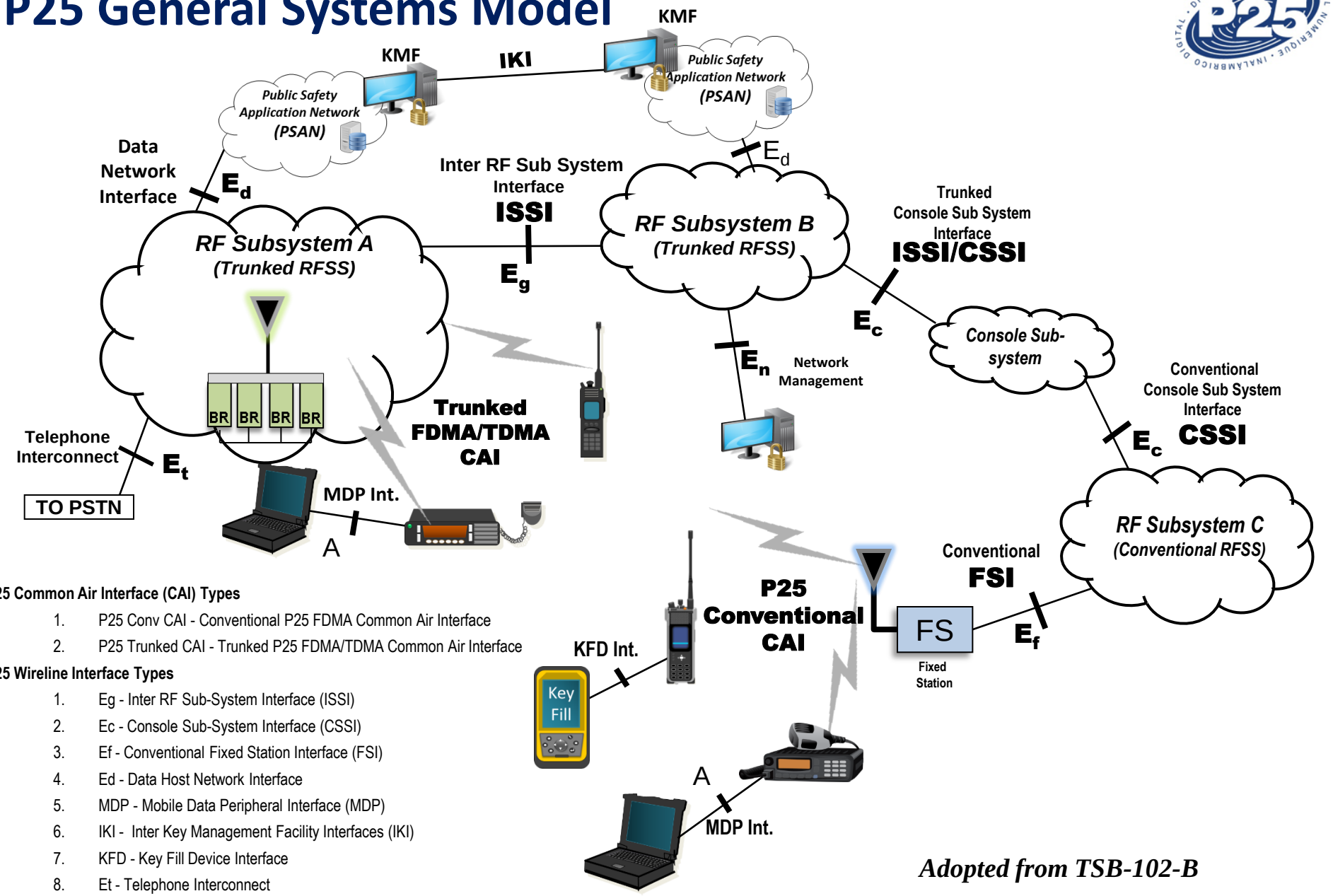
Thank you for your continued interest and support of the Project 25 Standard!

Cynthia Wenzel Cole, CEO

cynthia@cynergyze.com

@Cynergyze

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

Take Away Topics From Today

- Introduction to other P25 sessions of interest at IWCE
- A look at P25 in the market and supporting resources
- P25 Standards, the Process, and Why P25 is Useful to Users
- The many P25 Features and Interfaces
- A look at the Interface Definitions and Standards Completed
- The Reality of Multiple Vendor Interoperability with P25
- Use the PTIG Resources at - www.Project25.Org

Questions and Answers

P25 Presentations at IWCE College of Technology

- Monday AM
  - **Project 25 Foundations and System Interface Updates for 2014**
  - Session # M103 (This is Here and Now!!)
  - 8:30AM -12:00PM, Room N232

- Tuesday AM
  - **P25 User's Perspective and Customer Applications Update for 2014**
  - Session # T301
  - 8:30AM -12:00PM, Room N232

P25 Presentations at IWCE through This Week

- A Guide to Interoperability and “Open” Standards
- W03 - Wednesday, 03/26/2014, 11:00AM -12:15PM, Room S228.

- NPSTC Presents Current Public Safety Issues
- W07 - Wednesday, 03/26/2014, 11:00AM -12:15PM, Room S229.

- Building Interoperable Communications between Departments
- W11 - Wednesday, 03/26/2014, 1:15PM - 2:30PM, Room S228.

- Get Exactly What You Want: System Specifications, RFPs and Procurement
- W12 - Wednesday, 03/26/2014, 1:15PM - 2:30PM, Room S230.

- Migrating to P25
- TH05 - 03/27/2014, 9:45AM -11:00AM, Room S231.

P25 Presentations at IWCE through This Week

- DHS Update of the National Emergency Communications Plan
- TH07 - Thursday, 03/27/2014, 9:45AM -11:00AM, Room S229.

- Firefighter Tech: Radio Interference and Accessories
- TH23 - Thursday, 03/27/2014, 2:00PM - 3:15PM, Room S229.

- LMR and LTE: A Multi-Network Architecture for Future Communications
- TH26 - Thursday, 03/27/2014, 3:30PM - 4:45PM, Room S232.

- Migrating P25 Phase 1 to Phase 2: Best Practices
- F11 - Friday, 03/28/2014, 11:10AM -12:10PM, Room S231.

- All Things Considered: Building a Public Safety System for the 21st Century
- F12 - Friday, 03/28/2014, 11:10AM -12:10PM, Room S229.

PTIG Commercial Members

- AECOM
- Aeroflex
- Airwave Solutions
- Anritsu
- Avtec
- Cassidian Communications
- Catalyst Communications
- CISCO Systems
- Cobham Avionics
- Codan Radio (Daniels)
- Cynergyze
- Datron World Communications
- Digital Voice Systems Inc
- EFJohnson Technologies
- Etherstack
- Federal Engineering Inc
- Genesis Group
- Harris Corporation
- ICOM America
- Kenwood USA
- Midland Radio
- ModUCom
- Motorola Solutions
- Pantel International
- PowerTrunk
- Raytheon
- Radio Communication Systems Australia
- RELM Wireless
- Simoco ComGroup
- Spectra Engineering
- Tait Radio
- Technisonic Industries
- Telex Radio Dispatch
- Thales Communications
- Vertex Standard, Inc.
- Wireless Pacific
- Zetron, Inc.

COMPANY NAME	BOOTH #
Aeroflex	5051
Anritsu Company	7000
Avtec, Inc.	7019
Cassidian Communications	1007
Catalyst Communications Technologies, Inc.	2055
Codan Radio Communications Div.	8027
Datron World Communications, Inc.	1049
EFJohnson Technologies	4009; 4019
Etherstack	7009
Genesis Group, The	7056
Harris Corporation	3055
Icom America, Inc.	3032
IDA Corporation	2070
Kenwood USA Corporation	2001
Midland Radio Corporation	4121
ModUcom	4115
Motorola Solutions	5021
Powertrunk	7001; 2112
Raytheon Company	9001
RELM Wireless Corporation	5057
Rockwell Collins ARINC	3096
Simoco	9019
Tait Communications	7071
Telex Radio Dispatch	4071
Thales Defense & Security, Inc.	6009
Vertex Standard	5033
Zetron	5001

PROJECT 25 TECHNOLOGY INTEREST GROUP

Visit PTIG in Booth # 6070

OUR MEMBER ORGANIZATIONS AS IWCE EXHIBITORS ALSO SAY

THANK YOU