



Receiver Performance Standards for Public Safety

FCC Spectrum Efficiency and Receiver
Performance Workshop

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Dr. Dennis Martinez
Chief Technology Officer
Harris RF Communications Division

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Performance Standards for Public Safety Communications



- Most of the work on standards for the U.S. Land Mobile Radio (LMR) Public Safety market occurs at the Telecommunications Industry Association (TIA) through technical input from individual manufacturers.
- TIA is accredited by the American National Standards Institute (ANSI) to develop voluntary, consensus-based industry standards for a variety of industries via technical stakeholder input.
- More than 500 active participants, including telecommunications equipment manufacturers, service providers, government agencies, academic institutions, and end-users, drive TIA's standards setting process.
- To ensure that these LMR standards become globally established, TIA then collaborates with the International Telecommunication Union (ITU), the International Organization for Standardization (ISO), and the International Electrotechnical Commission (IEC).

- TR-8 Mobile and Personal Private Radio Standards
 - TR-8 formulates and maintains standards for private radio communications systems and equipment
 - TR-8 addresses technical matters including: definitions, interoperability, compatibility and compliance requirements
 - The markets addressed by these standards include public safety and business & industrial
- TR-14 Point-to-Point Communications Systems
- TR-30 Multi-Media Access, Protocols and Interfaces
- TR-34 Satellite Equipment & Systems
- TR-41 User Premises Telecommunications Requirements
- TR-42 Telecommunications Cabling Systems
- TR-45 Mobile and Personal Communications Systems Standards
- TR-47 Terrestrial Mobile Multimedia Multicast
- TR-48 Vehicular Telematics
- TR-49 Healthcare ICT
- TR-50 Smart Device Communications
- TR-51 Smart Utility Networks

TR 8 Work Committees and Groups



TIA APCO P25 Interface Committees

- TR-8 APIC APCO Project 25 Interface Committee (APIC)
- TR-8 APIC-APWG Audio performance Working Group
- TR-8 APIC-CAPPTG Compliance Assessment Process & Procedures Working Group CAPPTG
- TR-8 APIC-DTG Data Task Group
- TR-8 APIC-ETG APIC Encryption Task Group
- TR-8 APIC-FSITG Fixed Station Interface Task Group
- TR-8 APIC-ISSITG APIC ISSI Task Group
- TR-8 APIC-PRS Private Radio Section
- TR-8 APIC-STG System Task Group
- TR-8 APIC-TDMATG TDMA Task Group
- TR-8 APIC-VTG Vocoder Task Group

TR8-8 Working Groups

- TR-8.1 Equipment Measurement Procedures
- TR-8.3 Encryption Working Group
- TR-8.4 Vocoders
- TR-8.5 Signaling and Data Transmission
- TR-8.6 Equipment Performance Recommendation
- TR-8.8 Broadband Data Systems
- TR-8.10 Trunking and Conventional Control
- TR-8.11 Antenna Systems
- TR-8.12 Two Slot TDMA
- TR-8.14 Four Slot TDMA
- TR-8.15 Common Air Interface
- TR-8.17 RF Exposure
- TR-8.18 Wireless Systems Compatibility - Interference and Coverage
- TR-8.19 Wireline System Interfaces
- TR-8.20 International Affairs
- TR-8.21 Land Mobile Radio (LMR) Intrinsic Safety(IS) Consideration
- TR-8.25 Compliance Assessment

Key TIA Contributions



- TIA/EIA SP-4231 (formerly known as TIA/EIA-603) – “Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards”
- TIA 102 – Project 25 – Developed under an MOU executed in 1993:
 - Parties:
 - Association of Public-Safety Communications Officials(APCO)
 - National Association of State Telecommunications Directors (NASTD)
 - Federal Government Agencies (FED)
 - Key MOU provisions:
 - APCO/NASTD/FED will devise a Common System Standard for digital public safety communications
 - TIA would provide technical assistance in the development of documentation for the Standard
- Telecommunications Systems Bulletin TSB-88 “Wireless Communications Systems Performance in Noise and Interference Situations”
 - Part 1: Recommended Methods for Technology-Independent Modeling
 - Part 2: Propagation and Noise
 - Part 3: Performance Verification

- Receiver types
 - Fixed Station (Base station)
 - Mobile Station (Mobile radio)
 - Portable Station (Portable – handheld radio)

- Equipment Classes
 - Class A: Private Land Mobile Receivers with enhanced interference protection characteristics
 - Class B: Private Land Mobile Receivers

- Standards exist for both analog and digital systems

Key Standardized Receiver Performance Parameters (subset)



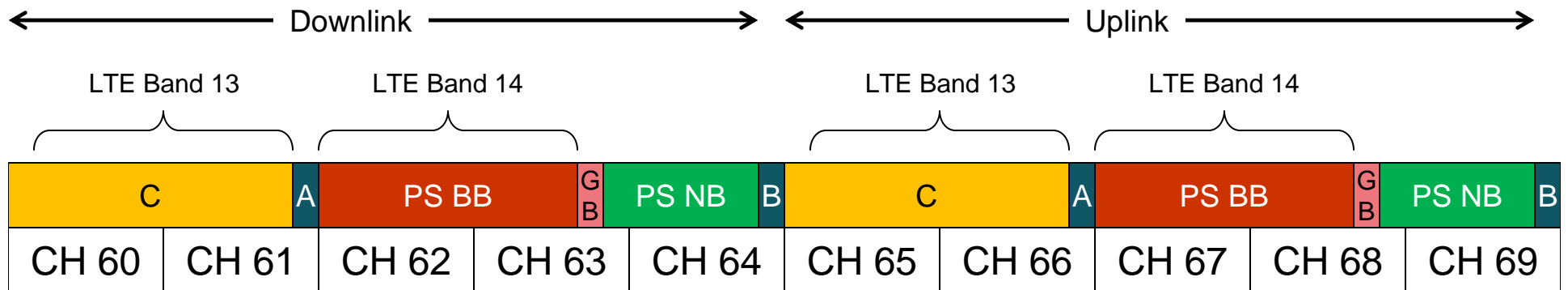
Parameter	Definition
Reference Sensitivity	Ability of receiver to extract very weak signals typical when there is large separation distance between the transmitter and receiver
Adjacent Channel Rejection	Ability to reject strong signals in adjacent receive channels This is particularly important in highly channelized environments such as LMR
Intermodulation Rejection	Ability to limit interference from mixing products generated in the receiver in the presence of two or more very strong interfering signals Receiver non-linearity
Blocking Rejection	Ability to reject strong interfering signals – usually associated with Rx overload/overdrive

Interference Challenges in Public Safety



- In real-world practice we find that even performance standards for Class A receivers are not adequate for many real-world scenarios
 - Common practice to exceed standards by significant amounts
- Significant challenges were encountered in the 800 MHz band from cellular systems
 - The 800 MHz Re-banding initiative is the long term mitigation plan being implemented
- Lessons learned with respect to mixed technology environments
 - Noise limited vs. Interference limited systems
 - High density vs. low density architectures
- Mitigation techniques
 - Co-location
 - Frequency coordination

Implications for 700 MHz Public Safety Narrowband and Broadband Systems



- There is 1 MHz separation between Band 13, Band 14 and PS – Insufficient for significant Rx pre-selector attenuation
- Public safety narrowband system design criteria typically require achieving a minimum voice quality metric over a jurisdiction’s land area with some statistical certainty
 - E.g. 95/95 = 95% coverage with 95% confidence factor at Delivered Audio Quality (DAQ) 3.5 or better
- This is fundamentally different from cellular system design criteria that is based on 5% throughput loss
- Design for interference management will be a key focus area in designing the 700 MHz broadband network to ensure co-existence with 700 MHz narrowband.
 - Coordination with Band 13 deployment will also be important

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- Leader in LTE and Land Mobile Radio (LMR) Critical Communications for Military and Public Safety.
 - Developing LTE devices, applications, and networks for Public Safety, leveraging technologies developed for U.S. military.
 - Leading participant in Public Safety Communications Research Program for LTE interoperability and technical committees for LMR interoperability.