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INTRODUCTION

Chairman Wu and distinguished members of the Subcommittee, thank you for inviting me to testify on *"Interoperability in Public Safety Communications Equipment."*

I am a senior scientist in the Public Safety and Professional Communications (PSPC) group of the RF Communications Division of the Harris Corporation. I have worked as an engineer/scientist and technical manager in the Land Mobile Radio (LMR) business for over 17 years for Harris and the predecessor companies of Tyco Electronics (M/A-COM) and Ericsson GE. For the last 10 years I have been leading the business' LMR TIA-Project 25 standards participation.

Harris strongly supports the TIA-P25 standards development and has identified more than 12 top senior Harris engineers to work on TIA-P25 standards development. A number of these senior engineers hold chair or vice-chair leadership positions in TIA and P25 subcommittees. For the last six years I have served as chair of two subcommittees involved in critical standards development: the TIA TR-8.12 two-slot TDMA subcommittee (next generation air interface) and the APIC Vocoder Task Group (speech coding standards). I also represent Harris on the P25 Compliance Assessment Program matters in the P25 community. From 1999-2003, I served on the Steering Committee of the Public Safety National Coordination Committee (NCC) FACA advising the FCC on interoperability channels/standards for the emerging 700 MHz public safety spectrum.

LMR products and associated standards represent the core business of Harris PSPC. Harris PSPC is a leading supplier of assured communication systems and equipment for public safety, federal, utility, commercial, and transportations markets – with products ranging from the most advanced IP voice and data networks, to industry leading multiband, multimode radios, to public safety-grade broadband video and data solutions. With more than 80 years of experience, Harris PSPC supports over 500 systems around the world.

Harris PSPC is a full capability P25 supplier with a full range of P25 radio products, systems, networks and services with over 50 P25 systems either fully deployed or currently being deployed in North America. Harris PSPC support of the P25 standard extends beyond products alone. The Harris P25 Compliance Assessment Laboratory in Lynchburg, VA was one of the first labs recognized by DHS as an interoperability and performance testing compliance lab to satisfy the DHS Compliance Assessment Bulletin (CAB) requirements for the P25 Ph 1 Common Air Interface. This facility has hosted several formal P25 CAP interoperability tests with P25 suppliers such as Motorola, E.F. Johnson, Kenwood, Tait, ICOM and Technisonic. Harris invests significant resources each year in the P25 standard process, product development and compliance assessment testing.

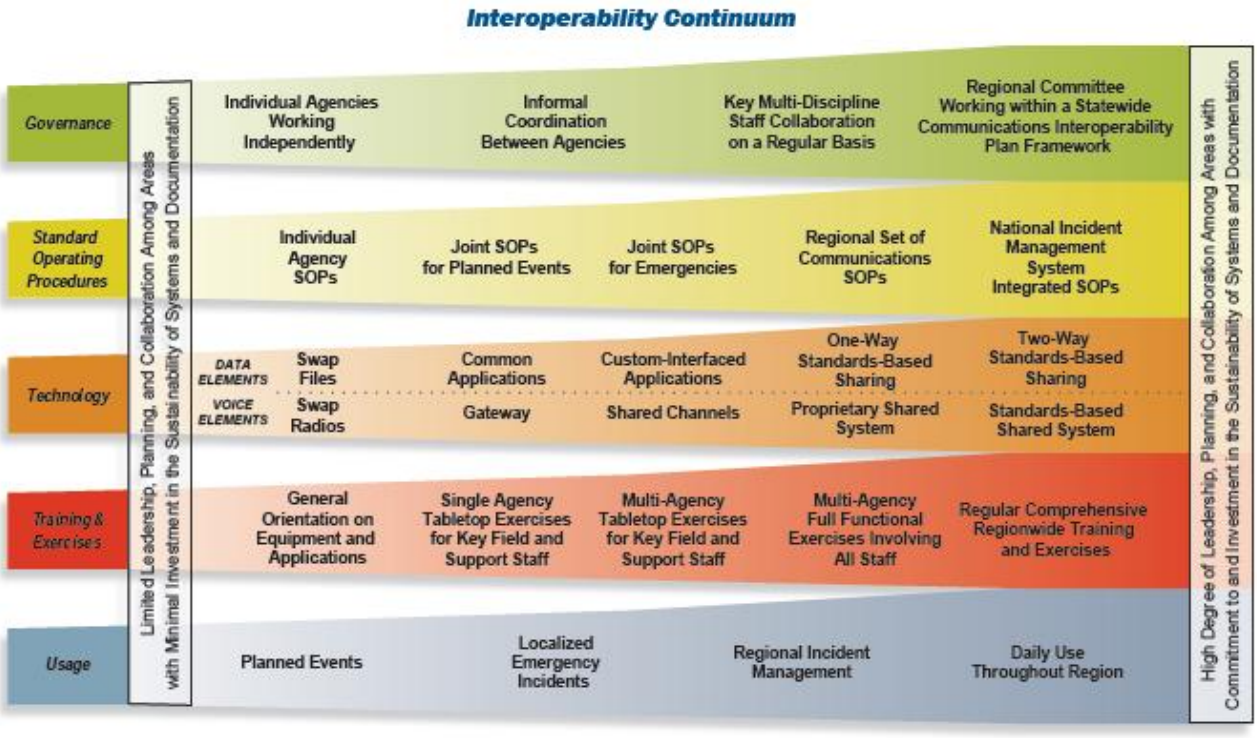
OVERVIEW COMMENTS ON PUBLIC SAFETY COMMUNICATIONS INTEROPERABILITY

Harris agrees with the description and characterization of interoperability on the DHS SAFECOM Interoperability website page[1] and in the DHS Interoperability Continuum Brochure:[2]

- What is communications interoperability? Wireless communications interoperability specifically refers to the ability of emergency response officials to share information via voice and data signals on demand, in real time, when needed, and as authorized.
- Interoperability is a multi-dimensional challenge involving five interdependent elements as illustrated in the diagram from the Interoperability Continuum Brochure:

[1] http://www.safecomprogram.gov/SAFECOM/interoperability/default.htm

[2] Interoperability Continuum, A tool for improving emergency response communications and interoperability, US DHS, from website http://www.safecomprogram.gov/SAFECOM/interoperability/default.htm, file Interoperability_Continuum_Brochure_2.pdf



The overall topic of *Interoperability in Public Safety Communications Equipment* and the subtopics of P25 standards status, customer confidence that P25 equipment will be interoperable, and recommendations on timely standards development and compliance assessment processes fall into the TECHNOLOGY element, so the remainder of the Harris testimony will focus on the TECHOLOGY ELEMENT.

TECHNOLOGY ELEMENT INCLUDING LMR STANDARDS STATUS

Technology Approaches – "Technology, including standards, for voice and data communications is a critical tool for improving interoperability, but it is not the sole driver of an optimum solution."[3] As displayed in the Technology bar of the Interoperability Continuum, there are a number of approaches to achieve increasing levels of interoperability: swapping radios, gateways, shared channels, proprietary shared systems, and standards-based shared systems. Harris believes that all of these approaches are deployed today to achieve varying levels of interoperability.

Several gateway products on the market enable effective interoperability among legacy analog communication systems and more modern digital communications systems. While the LMR radio spectrum is fragmented and split into multiple RF bands, certain bands through regulatory rules and/or frequency coordination practice have set aside

[3] From reference cited in footnote 2.

subsets of channels to be shared for interoperability. In particular, the narrowband portion of the 700 MHz public safety band has a number of dedicated interoperability channels with the guidelines and standard (P25 Ph 1 conventional) specified. The 800 MHz public safety band has set aside mutual-aid channels for interoperability.

The emergence of multi-band, multi-protocol radios that can communicate on several or all of the LMR bands with multiple radio protocols will enable increased levels of interoperability in the future. There are a number of proprietary shared systems where there are gateways as well as agreements and shared protocols in place to enable interoperability across these systems.

At the upper end of interoperability capability are standards-based shared systems. The predominant standard for these systems in the US is the TIA-102 P25 suite of Project 25 standards. The number of deployed P25 systems is increasing and the level of interoperability across these systems provided by different vendors is increasing as well with radios also supplied by different vendors.

Standards Status Summary[4] – As noted, the predominant LMR public safety standard in the US is the TIA-102 P25 suite of Project 25 standards.[5]

- Project 25 started in 1989 and has developed and continues to develop multiple standards in conjunction with TIA and in response to the user/practitioner driven Project 25 Statement of Requirements (SoR). The SoR evolves to reflect new user requirements and corresponding new and updated standards are developed.
- Currently, the TIA-102 P25 standards suite consists of approximately 69 published standards with about 13 in ballot as new, revised, or addendum standards, and with about 15 in draft. This suite addresses 11 defined Project 25 interfaces in the categories of service, system, and equipment.

[4] Status from three TIA documents: PN-3-3591-UGRV1(to be published as TIA-102), Project 25 System and Standards Definition, TIA Standard, January 2010 (in review for ballot in TIA-TR-8 committee); TR8docs.xls (Apr 28, 2010); and TR8proj.xls (Apr 28, 2010).

[5] The P25 standards have and continue to be developed under an MoU agreement between the Telecommunications Industry Association (TIA) as a sanctioned Standards Development Organization and the Project 25 Steering Committee representing APCO, NASTD, and the Federal Gov't

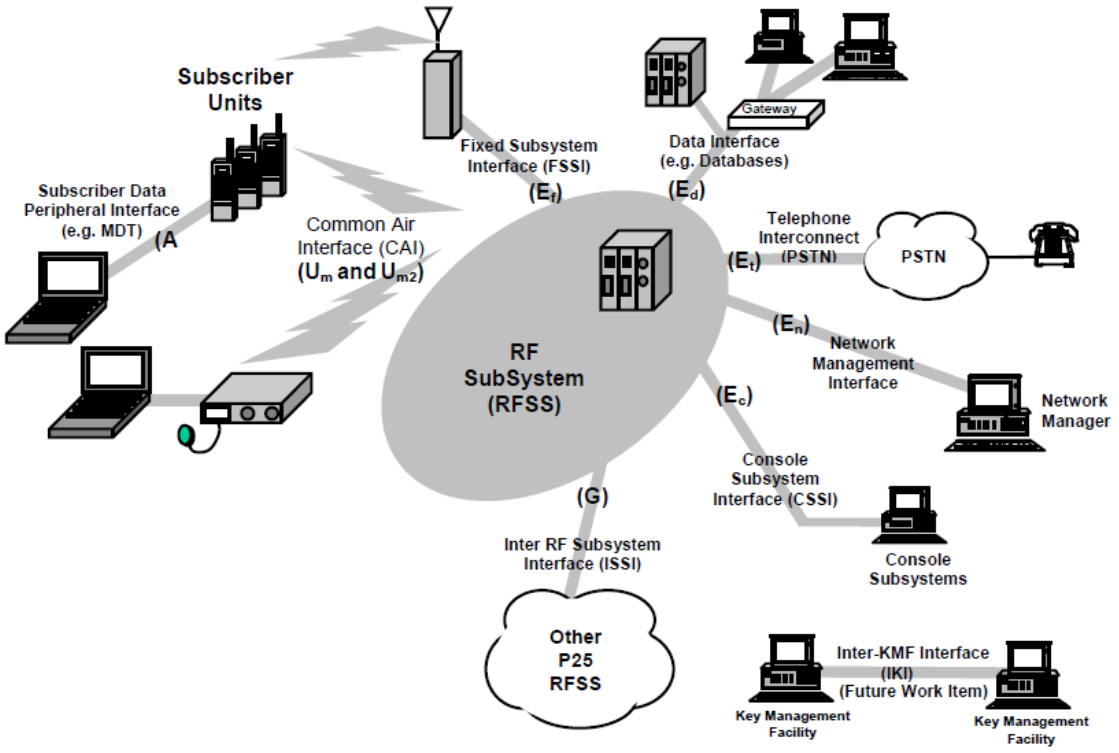


Figure 2-1 P25 Functional Network Model

- The P25 interfaces critical for interoperability and competition [the common air interface(CAI), the inter-RF subsystem interface (ISSI), and the fixed station interface (FSI)] are specified in more detail in the current suite than some other interfaces.
- The focus of the P25 standards development effort over the last couple of years is:
    - P25 CAP – developing the bulletins and standards associated with implementation of the P25 Compliance Assessment Program for the P25 Ph 1 trunked FDMA CAI, the ISSI, the Ph 1 conventional CAI, and then the P25 Ph 2 trunked TDMA CAI.
    - P25 Ph 2 TDMA CAI – completing the standards suite for the P25 Ph 2 trunked TDMA CAI for doubled capacity and 6.25 kHz per voice path spectral efficiency. The core definition standards needed for product development are complete or nearly ready for ballot. The associated test and measurement

documents for performance, interoperability, and conformance are well along in the drafting stage.

- ISSI Scopes 2 and 3 – completing Scopes 2 and 3 for the ISSI suite of standards. The Scope 1 standards are complete, support product development, and are mature for procurement. The core definition Scope 2 and 3 documents are well along with the supporting measurement documents in drafting. The P25 console interface standard (CSSI) is a subset of the ISSI standard suite.

- Security – completing the Inter KMF interface standards and encryption updates.

- While some not involved in the standards development process might comment that standards development takes a long time, the TIA process, like other Standards Development Organizations, is a consensus based process by design. The standards are developed by top engineers from industry who have the knowledge and perspective to assure successful product implementation to the standard. Getting to consensus and developing the requisite detail of the standard takes time, but the resultant standard product is technically solid and long lasting.

<u>Question 1a:</u> What is the status of the public safety land mobile radio standards process in terms of meeting the original Project 25 goals of enabling interoperability, competition among vendors, spectrum efficiency, graceful migrations from legacy systems, and user-friendly equipment?

Harris believes that the P25 community has made strong progress in meeting each of the cited original P25 goals.

- Enabling interoperability – radios & radio infrastructure: Detailed CAI radio product design and interoperability test standards are in place and multiple vendor radio products and infrastructure radio products have demonstrated a high functional level of interoperability through the formal CAI interoperability testing as part of the P25 Compliance Assessment Program (CAP) over the last year. As of May 24, 2010, twenty vendor radio products (or radio model classes) from four vendors (EF Johnson, Harris, Motorola, and Tait) have approved Suppliers Declaration of Compliance (SDoCs) posted to the official RKB website for information and review by public safety agencies and practitioners.

- Enabling interoperability – systems & networks: Detailed ISSI baseline product design and interoperability test standards are in place. P25 ISSI CAP requirements are in place. The first ISSI products are emerging. Informal ISSI interoperability

testing among a number of vendors has taken place. Formal ISSI interoperability testing as part of the P25 CAP is expected over the next year.

- Competition among vendors: Fairly strong competition among radio vendors has developed with over 15[6] vendors providing P25 radio products across a variety of frequency bands. Competition among P25 system and network vendors has developed with five vendors supplying P25 systems. Almost all large P25 system procurements have a separate system/infrastructure competition and user radio competition.

- Spectrum efficiency: From the start, the P25 Ph 1 FDMA CAI provided the 12.5 kHz narrowband capability and 12.5 kHz per voice path spectral efficiency required by 2013 for "narrowbanding" the below 512 MHz band and now in the 700 MHz band. The P25 Ph 2 TDMA CAI (two users in 12.5 kHz) standards, well along in development, will enable meeting the 6.25 kHz per voice path requirement for the 700 MHz band ahead of the Jan 1, 2017 deadline as well as the future (unspecified) requirement for the below 512 MHz band. In addition to satisfying the regulatory requirements, the P25 Ph 1 and Ph 2 CAIs are efficient in using the scarce public safety spectrum. The P25 Ph 2 CAI essentially doubles the capacity of a P25 Ph 1 system. In addition, both the P25 Ph 1 and Ph 2 CAIs are or will be deployed using trunking and simulcast techniques for enhanced spectral efficiency.

- Graceful migrations from legacy systems: Over the years, the P25 system vendors have successfully migrated many of their legacy customers to P25 according to the customer needs and plans and without disruption of mission critical communications. Harris has successfully migrated a number of its EDACS customers to P25 according to their needs and plans and there are a number of migrations in the planning process now.

- User-friendly equipment: Harris believes that P25 equipment is user-friendly, but, because of its complexity, formal training is highly recommended for the user to obtain the maximum benefit with efficiency. Harris believes that all P25 equipment vendors provide user manuals and offer formal training for their products.

<u>Question 1b:</u> How does the status of the standards process impact the communications equipment that public safety officials are buying today?

[6] P25 radio or related product vendors include: Harris, Motorola, EF Johnson, EADS, Tait, Kenwood, ICOM, Daniels, Relm, Datron, Thales, Teltronic, Technisonic, Zetron, and Futurecom.

- While the standard suite will continue to evolve with new and revised standards (otherwise the standards are dead) in response to the changing P25 SoR, Harris believes the current suite of P25 standards are rich and mature with corresponding products from several vendors so the public safety procurements can be assured of competition and functional capability to match the public safety user needs. The current suite, including the P25 Ph 1 FDMA CAI and the baseline ISSI offer a very solid and rich set of public safety features. There have been many P25 procurements over the last few years with a number underway now based on the current P25 standards suite and products.

- Almost all procurements specify a future smooth migration to new features on particular interfaces. Early adopters are specifying the coming P25 Ph 2 TDMA CAI for capacity and spectral efficiency or a definite migration timeline with committed costs to P25 Ph 2.

<u>Question 2:</u> What mechanisms exist for customers to have confidence that P25 equipment will be interoperable and function as intended?

- P25 Manufacturer Design and Extensive Internal Product Verification Testing Processes: Harris follows rigorous internal product design, test, and verification processes to achieve the highest practical assurance that our products meet design requirements, including standards, and have been tested to demonstrate the features offered in the product at both the product level and the system level. Harris follows a Stagegate Product Development Process consisting of five thresholds leading to production as part of the Harris Quality Management System that is registered and conforming to the requirements of ISO 9001:2008. Formal product and systems testing conducted by the Harris Systems Integrity group consists of Engineering Verification Testing (EVT), Systems Integration & Verification Testing (~ 6 months),and finally Final System Validation Testing including Field Validation Testing (~3-4 months). Formal P25 Compliance Assessment Program (P25 CAP) testing for the performance, interoperability, and conformance scopes as appropriate for the P25 interfaces within the P25 CAP is performed in a DHS Recognized P25 CAP Laboratory.

- Past/Current Industry Practice: Prior to the implementation of the P25 CAP, customers with a interoperability/function concern went directly to the manufacturer. If satisfaction was not received, the customer could go to the appropriate TIA-P25 subcommittee for resolution. This process continues today. A few years ago, there were a number of issues identified in P25 systems being deployed and these issues were treated in an informal Hosted Manufacturers Interoperability Board (HMIB). After resolution of this set of issues, the HMIB was transitioned into the formal TIA

TR-8.25 P25 Compliance Assessment subcommittee. In many cases, interpretation of the standard created the issue and the solution was to clarify the standard with revisions and upgrades. The majority of this standards cleanup work has been done. Products compliant with the newer standard versions should not have issues of interoperability. Also, in many cases. for newer interfaces the standards are consensus "Greenfield" so challenges with legacy implementations should be much reduced.

  - As a result of the HMIB and associated activity, the P25 manufacturers with deployed or deploying systems developed a practice of communicating and resolving cited interoperability items. There are communications between the systems experts of Harris and Motorola on cited interoperability items so that these items can be understood and resolved. Over the last few years, vendors have deployed multiple P25 systems that are operational with radio user equipment from one or several other vendors. Harris has at least two deployed and operational P25 systems for which all the user radios are supplied by other vendors.

- P25 CAP: Recently, DHS recognized laboratories are implementing the P25 Compliance Assessment Program (CAP) that performs formalized testing to standards and requirements to provide additional assurance of interoperability, performance, and conformance (to the standards) for critical P25 interfaces. The results of the formal P25 CAP testing for the product under test are documented in SDoCs (Supplier's Declaration of Compliance) and STRs (Summary Test Reports). The SDoCs and STRs are reviewed by DHS and posted to the reference repository, the RKB (Responder's Knowledge Base) available to public safety procuring agencies and practitioners. The P25 interfaces incorporated into the P25 CAP are: the P25 Ph 1 trunked FDMA CAI, the ISSI, the P25 Ph 1 conventional FDMA CAI, and then the P25 Ph 2 trunked TDMA CAI.

  Harris supports a solid, practical DHS P25 Compliance Assessment Program (P25 CAP) and associated testing for the benefit of our customers, other public safety agencies/users, and manufacturers. Harris developed and maintains a DHS Recognized P25 Compliance Assessment Laboratory, recognized in May 2009, for the required scopes of P25 CAP CAI Baseline testing for performance and interoperability. The Harris Recognized Laboratory has performed performance testing on its P25 radio products and has hosted formal P25 CAP interoperability testing for multiple P25 radio product vendors. Similarly, Harris P25 radio and infrastructure products have been tested at two other Recognized Laboratories. As a result of this testing, SDoCs and STRs for seven Harris P25 products (or radio model classes) are now posted on the RKB website.

- Procurement Requirements: As part of procurement requirements, procuring agencies can specify demonstration of any special interoperability and function requirements including, or in addition to, the P25 CAP.

- Special Testing as Part of Contract: Procuring agencies can also specify certain interoperability and functional testing, including or in addition to, the P25 CAP as part of their Customer Acceptance Testing.

Question 3: What recommendations do you have to ensure that the standards development and compliance assessment processes meet the needs of public safety in a timely manner?

- Although challenging, the P25 suite of standards could be organized into "releases" like some other standards to simply and clarify the description of standards content over time; i.e., Release 1, Release 2, Release 2.1 etc. P25 products could then be marked as compliant with P25 Release 1, P25 Release 2 etc. This could also simplify any P25 product compatibility descriptions.

- Again, although challenging and having been discussed a number of times by users and manufacturers in the P25 standards community, the array of P25 mandatory and standard option features could be grouped or packaged into levels of increasing capability; i.e., P25 Level 0 (baseline); P25 Level 1 (Level 0 plus more features); P25 Level 2; etc. This grouping of features could make the product marking of features supported and the P25 CAP testing of features packages more simplified and efficient.

- Agreement among public safety agencies on the features for interoperability, as defined by several levels of interoperability, would be beneficial. These levels could include: P25 Interoperability Capability 0 (baseline); P25 Interoperability Capability 1 (Capability 0 plus more features), etc. This grouping of interoperability capability features would make specification and testing of interoperability simpler, more efficient, and adaptable to the interoperability needs of various public safety agencies.

- Prioritizing the consensus-based standards development according to the needs of the public safety agencies and the industry capability to support the development is important.

- As a slight note of caution, Harris urges the subcommittee to consider an appropriate balance among testing, regulatory requirements and flexibility for innovation within the P25 standards and products. Harris certainly supports rigorous testing for compliance for mission-critical public safety communication products and

systems. While it can be argued that more testing is always good and may catch an unusual behavior or concern, there is a point where additional testing, especially redundant testing, does not add significant assurance benefit. It is possible that "over-testing" and regulation requirements could become a barrier to entry into the P25 market for smaller companies and deter a larger base of competition. Also, for P25 manufacturers, the necessity of supporting any over testing and regulation requirements will divert critical engineering resources from advancement of new P25 standards and the development of new P25 product features. It will inevitably increase the time for completion of certain standards and increase the time-to-market for some product features that are much requested by public safety agencies.

CONCLUSION

Chairman Wu and other members of the Subcommittee, thank you for the opportunity to testify today and share with you the Harris Corporation views on *Interoperability in Public Safety Communications Equipment.* As previously noted, interoperability is a multi-dimensional challenge that involves five interdependent elements. These elements, as illustrated in the diagram from the DHS Interoperability Continuum Brochure, include Governance, Standard Operating Procedures, Technology (including LMR standards), Training & Exercises, and Usage. The level of interoperability achieved depends on the progress in each of the elements and the coordination/management of all five elements. My remarks today have focused on the Technology (including LMR standards) area where we at Harris believe that substantial progress has been achieved in recent years in the establishment of practical technical solutions and approaches. For the higher levels of interoperability based on standards-based shared systems, Harris believes that while more work is needed, strong progress has been made in recent years through continued TIA-P25 standards development, P25 CAP testing, and public safety agency procurement requirement and practices that include separate system infrastructure and user radio procurements. The P25 product standards, the testing standards, and product features are in place or soon will be in place to enable a solid level of P25 trunked and conventional systems interoperability.