U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION

HEARING CHARTER

Progress on P25: Furthering Interoperability and Competition for Public Safety Radio Equipment

Thursday, September 23, 2010
2:00 p.m. – 4:00 p.m.
2318 Rayburn House Office Building

I. Purpose

The Project 25 standard for digital land mobile radios is intended to further seamless communications interoperability among America's first responders, enable competition among radio equipment manufacturers, and provide for the efficient use of limited spectrum resources. In May of 2010, the Science and Technology Committee's Subcommittee on Technology and Innovation held a hearing to discuss the status of the Project 25 standard and the remaining challenges. This hearing will discuss these challenges further and explore how the status of Project 25 affects an array of stakeholders.

II. Witnesses

- **Mr. Tom Sorley,** *Deputy Director Radio Communication Services, City of Houston Information Technology Department*
- **Ms. Ellen O'Hara,** *President, Zetron*
- **Mr. Marvin Ingram,** *Senior Director, ARINC, Public Safety Communications*
- **Mr. Russ Sveda,** ***Manager of the Radio Technical Service Center,*** *Department of the Interior*

III. Brief Overview

In 1989, the public safety community joined together to address the lack of interoperability between digital radios supplied by different vendors through the development of the Project 25–or P25–technical standard for digital land mobile radios (LMRs). For over a decade, the P25 process made minimal progress in completing the standards. However, major disaster events (including the September 11th attacks and Hurricane Katrina) renewed motivation to drive the process forward and eliminate the

technical barriers that prevent public safety officials from different agencies and jurisdictions from communicating during an emergency response.

In a May 2010 hearing, the Subcommittee heard testimony on this progress, as well as on what some viewed as remaining challenges. For example, witnesses disagreed on the status of the P25 standards. Whereas witnesses representing two federal agencies claimed that many of the technical documents within the suite of P25 standards were not yet completed, those representing equipment manufacturers argued the standards were "functionally complete," enabling engineers to build interoperable equipment. Witnesses also debated the degree and rigor of testing that should be required to verify manufacturers' claims that radio systems are P25-complaint.

This hearing will continue the Technology and Innovation Subcommittee's examination of the P25 standard, and explore how the status of the standards documents and the testing requirements impact P25 stakeholders. This hearing will also review the role of the P25 standard in ensuring radio systems are interoperable and that there is competition among vendors.

IV. Background

Project 25

The lack of interoperability—often defined as the ability of emergency responders to communicate with whom they need to, when they need to, and as authorized—has long challenged America's public safety community. Interoperability problems between responding agencies were documented in the response efforts to the 1995 Oklahoma City bombing, the September 11th attacks, and Hurricane Katrina, making response efforts more chaotic, less efficient, and even more dangerous. In the World Trade Center attacks, firefighters did not receive the New York Police Department message to evacuate the building immediately, contributing to the deaths of those firefighters. In the response to Hurricane Katrina, officials in helicopters could not communicate with responders in boats, slowing rescue efforts. First responders in these cases, and other large-scale events, ended up employing message runners, which limited the flow of information to incident commanders.[1]

While planning, governance, and training are essential components of interoperability, standards-based technology is generally accepted as critical to achieving seamless interoperability either in an emergency or during day-today operation.[2] The emergence of digital technology in the late 1980s highlighted the importance of standards in ensuring interoperability. These digital radio systems used proprietary protocols and

[1] Tristan Weir, *Federal Policy Toward Emergency Responder Interoperability: A Path Forward*. Thesis submitted for a Masters of Science in Technology Policy from the Massachusetts Institute of Technology, 2006.

[2]Department of Homeland Security, SAFECOM Program's Interoperability Continuum tool, available at: http://www.safecomprogram.gov/NR/rdonlyres/54F0C2DE-FA70-48DD-A56E-3A72A8F35066/0/Interoperability_Continuum_Brochure_2.pdf.

technology which, unlike their analog forbearers, were incompatible with the proprietary technologies of other vendors, even when those radios were deployed within the same spectrum band.[3]

In 1989, to escape proprietary systems and promote interoperability, the Association of Public-Safety Communications Officials (APCO) and the National Association of State Telecommunications Directors (NASTD), along with several federal agencies, began work on the P25 suite of standards for digital LMR systems. The originators of P25 sought to develop a user-defined and user-driven standard that would allow for interoperability, multi-vendor procurement, and the transition from legacy analog equipment to digital equipment, as well as promote greater spectrum-use efficiency.[4]

The APCO process eventually led to a partnership between the public safety community and the Telecommunications Industry Association (TIA)[5] to collaborate on standards. Through a process agreed to by TIA and the participating representatives from the public safety community, public safety users define the requirements for the standard and the standards documents are then produced by engineers from TIA and digital radio manufacturers who volunteer their expertise.

Representatives from several federal agencies were among the original participants in P25. However, the slow rate of progress toward greater interoperability spurred Congress to direct the Department of Homeland Security to take a more active role in promoting interoperability and hastening the development of the P25 standards. The 2004 *Intelligence Reform and Terrorism Prevention Act* (P.L. 108-458) directed the Secretary of Homeland Security to establish a program to improve the state of interoperable communications capabilities for first responders. Among other requirements and activities, the legislation directed the Department of Homeland Security to work—in consultation with NIST, the private sector, and others—to "accelerate the development of national voluntary consensus standards for public safety interoperable communications." Since the passage of the Act, NIST, through the Public Safety Communication Research Program (a joint program between NIST and the National Telecommunications and Information Association), has taken leadership roles in the P25 standards development process, particularly in areas of testing and certification.

A 2007 Government Accountability Report (GAO) report[6] noted that, despite over $2 billion of federal spending to advance interoperability, communities across the country were still far from achieving that goal. GAO identified a number of barriers to interoperability, but also cited the slow rate of P25 standards development as among the factors hindering faster adoption of interoperable public safety communications systems.

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[3] COPS Interoperable Communications Technology Program, May 2007 Issue Brief, *Project 25:The Quest for Interoperable Radios*, by Dan Hawkins, available at: http://www.dps.mo.gov/homelandsecurity/documents/SEARCHP25Primer.pdf.

[4] *Id.*

[5] The Telecommunications Industry Association is an ANSI-accredited standards development organization.

[6] GAO Report 07-301, April 2007. *First Responders—Much Work Remains to Improve Communications Interoperability.*

GAO noted that while the P25 standards developers took four years (from 1989 to 1993) to develop the Common Air Interface (defined below), they did not complete any additional standards between 1993 and 2005. GAO found that P25 participants had made "significant progress" on the standards for interoperability after 2005, but that many standards were still incomplete. Further, GAO reported that tests conducted between 2003 and 2006 showed that inconsistent interpretations of the standards caused P25 radios to fail aspects of interoperability tests.

P25 encompasses a suite of standards, each of which defines the technical requirements necessary for components of the radio system infrastructure to interface—or interoperate—with one another. Public safety land mobile radio (LMR) systems include the portable handheld and car-mounted radios used by emergency responders, as well as fixed infrastructure such as towers, base stations, and console. Those P25 standards identified as most critical to interoperability are listed below:[7]

- **The Common-Air Interface (CAI)**, which defines the communication protocols between radio transmitters and receivers. This standard is intended to ensure that a portable radio from one manufacturer can communicate with a portable radio from a different manufacturer.
- **The Console Subsystem Interface (CSI)**, which defines how radio frequency components of the system and console (such as the equipment used by dispatchers) connect with one another.
- **The Fixed Station Interface (FSI),** which defines how components of the radio system that are fixed in place (such as base stations) connect with other components of the system.
- **The Inter-RF subsystem Interface (ISSI),** which defines the connection between different radio system networks.

Compliance Assessment Program (CAP)

Standards are technical documents, but engineers may vary in their interpretation of the protocols included in the documents. Ultimately, this variability in interpretation can impact the functionality of equipment. For this reason, in the case of many telecommunications standards – such as Wi-Fi or BlueTooth, the relevant industry stakeholders develop testing and certification processes to ensure products meet the specifications of the standards and that the standard is being interpreted consistently among vendors.

For many years P25 lacked a formal testing process to validate that manufacturers had correctly and uniformly implemented the standards in their equipment and were not misappropriating the P25 label. In 2005, in response to reports of failed interoperability tests of P25-labeled equipment (between different manufacturers, and even between

[7] COPS Interoperable Communications Technology Program, May 2007 Issue Brief, *Project 25:The Quest for Interoperable Radios*, by Dan Hawkins, available at: http://www.dps.mo.gov/homelandsecurity/documents/SEARCHP25Primer.pdf.

different models from the same manufacturer), Congress directed the Department of Homeland Security (DHS), working with the Department of Justice (DOJ) and the National Institute of Standards and Technology (NIST), to develop a P25 Compliance Assessment Program (CAP).[8] The DHS CAP certifies laboratories and specifies which tests must be conducted to show compliance with the standard. The DHS CAP is a voluntary program, but any P25 digital radio systems purchased with DHS grants must meet the requirements of the program.

The P25 CAP sought to specify testing requirements for performance, interoperability, and conformance.[9] Conformity assessment tests whether manufacturers have correctly and consistently interpreted and implemented the standard. It is generally more rigorous than interoperability and performance testing and it is arguably the best mechanism for ensuring that all standardized functions will interoperate across all manufacturers. Conformance testing is also considered particularly important in ensuring backwards compatibility of new technology, which must connect and interoperate with legacy systems, some as many as 20 years old or older.

May 2010 Hearing

On May 27, 2010, the Subcommittee on Technology and Innovation of the House Committee on Science and Technology held a hearing on the status of interoperability for public safety communications equipment. The Subcommittee heard testimony from the public safety community, federal agencies, and major manufacturers of radio equipment.[10] The hearing addressed the status of the P25 standards and the degree of testing needed to ensure that P25 products conform to the applicable standards.

The witnesses made different arguments on the scope of P25 and the impact the status of the process had on digital radio equipment being fielded today. Witnesses from DHS and NIST identified eight interfaces (i.e., standards) encompassed by P25, and according to NIST's testimony, only one and a half of the eight interfaces were complete. The witness testified that:

> *To date, only the conventional portion of the CAI and the Inter-RF-Subsystem Interface have a completed suite of documents[11] . . . The more complex trunked[12] CAI continues to lack*

[8] Directed in the *FY2006 Department of Homeland Security Appropriations Act* (H. Rept. 109-241)

[9] *Charter for the P25 Compliance Assessment Program, April 2008*, available at: http://www.safecomprogram.gov/NR/rdonlyres/D295A545-44A4-4226-AAF7-56A33684908E/0/Project25ComplianceAssessmentProgramCharter.pdf

[10] Witnesses at May 27th Hearing: **Dr. David Boyd**, Director of the Command, Control, and Interoperability Division of the DHS Science and Technology Directorate; **Mr. Dereck Orr**, Program Manager for public Safety Communication Systems, at NIST; **Dr. Ernest Hofmeister**, Senior Scientist at the Harris Corporation; **Mr. John Muench**, Director of Business Development for Motorla, Inc.; and **Chief Jeffery Johnson**, President of the International Association of Fire Chiefs, and Chief of Tualitin Valley Fire and Rescue, Aloha, Oregon.

[11] From testimony provided by Dereck Orr: for P25, each complete interface, or standard, includes five documents--a protocol document, which provides the details to implement the particular interface, and three test documents (tests for performance, interoperability, and conformance), which allow manufacturers

conformance test documents . . . although trunked CAI products have been sold for almost a decade. The remainder of the six interfaces is in various stages of document completion.

The witness further testified that because the P25 standards remain incomplete, radio systems that are sold as P25 are in actuality only partially standards-based.

LMR industry representatives did not dispute that P25 was technically incomplete, but they stressed that the standards needed to change as technology evolved and argued that the available standards actually enable interoperability across vendors. Motorola, a major manufacturer of LMR equipment, held that "the technical specifications for Project 25's Phase 1[13] systems are functionally complete." Accordingly, the industry representatives pointed out that the P25 standards documents completed to date enable two important functions: (1) ensuring that a P25 portable radio can communicate directly with any other P25 portable radio in the same spectrum band; and (2) allowing a first responder, within the coverage area of a neighboring network, to communicate with his/her home network (e.g., dispatchers) through the neighboring network.

The manufacturer representatives also noted that P25 developers have generated approximately 69 published standards, with an additional 13 in the ballot phase and 15 in the draft phase. Given that the standards development process relies on the voluntary efforts of expert engineers, and consensus amongst all of the stakeholders, Harris' testified that "the standards pace is at full industry and user capacity."

Witnesses at the hearing also disagreed about the degree of testing that should be required to validate that products meet the standards. NIST testified that the CAP attempted to create a rigorous and formal testing program, while minimizing the burden the testing requirements would impose on industry. NIST noted that not only does the CAP not require third-party certification, CAP developers leverage the testing standards developed and published by the P25 standards developers themselves.

Federal Government witnesses also noted that, although the CAP as originally planned was to include interoperability, performance, and conformance testing for all completed interfaces, the first P25 CAP requirements (which were issued in 2008) did not include conformance testing. Those requirements covered only the CAI standard, which—at the time—was incomplete and included no conformance testing documents. NIST and DHS further testified that manufacturers strongly objected to a proposal to include conformity testing for the ISSI standard, which had a completed conformance testing document, in

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to "comprehensively test their implementations in a common way" to limit variants in interpretation of the protocol. All of these documents are developed via a consensus process.

[12] Trunked radios are considerably more complex than conventional. In a trunked radio system, users are not assigned to particularly frequencies, but instead have access to any frequency that is open, and are connected automatically via the system. Not being confined to assigned channels allows more efficient use of the frequencies because more users can be on the system at any given time.

[13] As noted in the testimony provided by Motorola and Harris, Phase 1 of Project 25 refers to enabling communication at bandwidth's of 12.5 kHz to comply with FCC "narrow-banding" requirements. Phase 2 will further reduce the width of the communication channel to 6.25 kHz in anticipation of future FCC mandates to use limited spectrum resources more efficiently.

the CAP in 2009. The agency witnesses voiced strong support for including conformance testing, arguing it was the best tool to ensure interoperability and backwards compatibility with legacy systems.

At the hearing, the manufacturer representatives noted that both of their companies follow rigorous internal testing procedure, and had worked extensively with other companies, and within the P25 process, to resolve identified interoperability problems. Harris noted that past interoperability problems reflected ambiguities within the P25 standards, which have subsequently been resolved, and should no longer pose problems. Motorola contended that any interoperability problems found today are likely a result of differences in equipment configuration between radio systems.[14]

While the manufacturers were supportive of the P25 CAP, they questioned whether the benefit of more rigorous testing would outweigh the cost. Both Harris and Motorola pointed to the costs of developing the needed equipment to perform the tests. They also noted that while conformance testing is routinely done in the telecom industry, the public safety equipment industry and market is significantly smaller and testing would therefore be more burdensome.

The charter, witness testimony, and webcast to the May hearing can be found on the Science and Technology Committee's website (http://science.house.gov/publications/hearings_markups_details.aspx?NewsID=2866). In addition, responses to Questions for the Record for that hearing, which are not yet published, are included in an appendix to this charter.

700 Mhz and Public Safety Broadband Networks

The P25 standards cover interoperability for voice communications over digital LMR systems. With the availability of broadband, many public safety agencies are seeking to integrate data functions into their operations. Generally, public safety agencies that seek to integrate these functions now must rely on commercial carriers to provide broadband service. However, the National Broadband Plan recommended the creation of a nationwide interoperable public safety wireless broadband network, which would allow data and extra voice capacity for public safety.

Many policy and technology issues may need to be resolved before more widespread implementation of public safety broadband networks is possible. In addition to questions

[14] As noted by NIST in response to Questions for the Record (located in the Appendix to this charter), methods for the configuration, or programming, of radios vary across manufacturers. Such programming is complex, and made more complex by the number of features present in a particular radio. The lack of standardized methods for programming can lead to interoperability, as well as operability, problems, particularly in an emergency response setting, where time is critical. However, NIST further noted that " . . . in discussions with public safety organizations responsible for the provisioning of radios operating on a system, we have been informed that many of the issues found in the radios also require software upgrades to the radios themselves rather than a simple reconfiguration. Thus we are confident that some issues found in the field are due to problems beyond configuration and programming, and are instead due to non-conformance to the standard or problems with the standard itself."

about the fate of the "D-Block" (an additional 10 Mhz of the 700 band spectrum) and debate on how to govern, finance, and build a network for public safety, significant issues arguably remain with respect to standards and testing. NIST and the National Telecommunications and Information Administration (NTIA) have worked with the public safety community over the past three years to define the technical requirements needed for a public safety broadband network. Working with the broadband industry, NIST and NTIA are also developing a test-bed to test broadband technology against public safety needs. Testing will begin early next year. Public safety-specific standards for broadband technology have not yet been addressed in an organized fashion.

V. Issues and Concerns

Even in their current state, the P25 standards have improved interoperability for public safety radios. LMR vendors have shown that handheld and portable radios from different manufacturers can communicate with one another. However, there are unanswered questions on whether further progress is still needed to address two key goals of the P25 process: (1) ensuring seamless and reliable interoperability, and (2) fostering competition for public safety communications equipment.

Although representatives from industry claim that the P25 standards are "functionally complete", concerns persist that currently fielded P25 systems are not completely standards-based. In addition, questions remain on the extent to which testing should be required to validate that products meet the standard.

Though there are clear disagreements over these technical matters, it is less clear what the consequences of these disagreements are for the interoperability of the equipment and for ensuring competition among vendors in the P25 equipment market. Further discussion of the practical impacts of these issues should help provide more insight into whether, and to what extent, the P25 process is meeting its original goals.

APPENDIX

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION

HEARING ON

Interoperability in Public Safety Communications Equipment

May 27, 2010

Questions for the Record Submitted to:

Dr. David Boyd
Director, Command, Control & Interoperability, Science and Technology Directorate
Department of Homeland Security

Questions Submitted by Subcommittee Chairman Wu

(1) P25 equipment purchased with DHS grant dollars must follow the CAP testing and evaluation requirements. How does DHS monitor the grant programs to ensure that grantees follow this requirement?

Response: The DHS Office of Emergency Communications (OEC) and the Office for Interoperability and Compatibility (OIC) support SAFECOM's development of guidance, research, testing, and standards of communications technology. SAFECOM issues an annual document titled "Recommended Guidance for Federal Grant Programs" to provide a point of reference for Federal grant programs that fund interoperable emergency communications activities. The guidance is intended to ensure that Federal grant funding for interoperable communications aligns with national goals and objectives and ensures alignment of state, local, and tribal investment of federal grant funding to statewide and national goals and objectives.

The SAFECOM guidance specifically states that when a grantee procures P-25 equipment and systems they should, at a minimum, "ensure the vendor has participated in equipment testing consistent with the Project 25 Compliance Assessment Program (P25 CAP)"

FEMA/GPD acknowledges this guidance and incorporates it by citation into all grant guidance and application kits, "States that are using FY 2010 HSGP funds to purchase Interoperable Communications Equipment…must consult SAFECOM's coordinated grant guidance, which outlines standards and equipment information to enhance interoperable communications."

FEMA/GPD does not monitor its grantees to ensure they follow the P25 CAP requirement. However, in an effort to assist grantees purchasing communications equipment, information related to the P25 CAP has been incorporated into the Responder Knowledge Base (RKB) website, which maintains the DHS Authorized Equipment List. P25 vendors can now include test result summary reports and a Supplier's Declaration of Compliance (SDoC) on the RKB for grantees to reference.

The grant program that most directly addresses the P25 CAP is the Public Safety Interoperable Communications (PSIC) grant program, which is administered by both FEMA/GPD and the National Telecommunications and Information Administration (NTIA). Approximately 90

percent of all available PSIC funding ($848 million out of the available $968 million) is being used by grantees to acquire and deploy equipment to improve interoperable communications.

As background, the PSIC Grant Program Guidance and Application Kit released in August 2007 stated that:

"Agencies purchasing Project 25 (P25) compliant equipment must obtain documented evidence from the manufacturer that the equipment has been tested to and passed all of the applicable, published, normative P25 compliance assessment test procedures for performance, conformance, and interoperability as defined in the "Grant Guidance—Project 25 Explanatory Addenda," which can be found at www.safecomprogram.gov/SAFECOM/grant/defaults.htm."

In June 2009 with the designation of the initial eight laboratories approved to test equipment under the P25 CAP, PSIC program managers and officials from the Office of Emergency Communications (OEC) met with the National Institute of Standards and Technology (NIST) Office of Law Enforcement Standards and received guidance on the program. The PSIC Grant Program included language in its technical assistance offering in the National Preparedness Directorate Technical Assistance Catalog.

(2) Acknowledging that P25 is a work in progress, at the end of his testimony, Dr. Hofmeister suggested that defining the standard functions and features included within a "package" may offer public safety a clearer picture of the functionality of the LMR systems they are choosing. What are your thoughts on this recommendation, or on other ways of providing agencies with a better window into the status of P25 and the implications the status may have on functionality?

Response: Defining the standard functions and features required to identify a product as P25 compliant would provide greater transparency to the public safety community. A common definition for the sets of features offered by manufacturers could be beneficial, but only if it better informs the public safety community's procurement process and defining these feature sets does not cause additional delays. When there is a common definition of features across manufacturers, public safety officials can directly compare equipment based upon its functionality and how it will meet their requirements. This transparency combined with a robust compliance assessment program, including conformance testing, will provide increased confidence that equipment will meet the needs of the public safety community. (Conformance testing demonstrates how equipment conforms to the standard and will interoperate with all compatible equipment that correctly implements the standard, including equipment that was not tested.)

The Office for Interoperability and Compatibility (OIC) and the National Institute of Standards and Technology (NIST) are actively working to provide more information on P25 to the public safety community. The P25 Document Suite Reference identifies the current status of the highest priority P25 standards. Manufacturers are also required to submit Suppliers' Declaration of Compliance (SDoC) and Summary Test Reports. The SDoC is the manufacturer's formal, public attestation of compliance with the standards for the equipment. The Summary Test Reports provide the equipment purchaser with a summary of the tests conducted on the equipment along with the testing outcome. All of these documents are available to the public safety community through the Federal Emergency Management Agency's Responder Knowledge Base Web site (https://www.rkb.us/) and through NIST's Public Safety Communications Research Program Web site (http://www.pscr.gov/).

(3) In your testimony you mentioned that there are products in the field that were built in the early phases of P25 and that these systems, though labeled P25, may not interoperate. How widespread is this problem and how well aware are public safety agencies that their older P25 systems may not interoperate with newer systems?

Response: There are more than 50,000 public safety agencies throughout the United States, each with its own local and state government regulations and requirements that can impact

interoperability. It is difficult to assess how widespread the problem is. Often responders do not know whether they can truly communicate until the need to interoperate with different agencies arises. Based on our work in the field, there is a perception in the public safety community that buying P25 equipment does not guarantee interoperability. The perception that P25 equipment does not interoperate has impacted the pace of adoption. The best way to ensure P25 systems can communicate and also improve the public safety community's confidence in these systems is to have a robust compliance testing program that includes conformance testing.

The Department of Homeland Appropriations Act, 2007, (P.L. 109-295, Title VI, §672(a) (October 4, 2006) amended the Homeland Security Act of 2002 (Act), by adding a new section 314 to that Act. Under section 314, codified at 6 U.S.C. 195, the Director of the Office for Interoperability and Compatibility is required to, among other things, in coordination with the Federal Communications Commission, the National Institute of Standards and Technology, and other Federal departments and agencies with responsibility for standards, support the creation of national voluntary consensus standards for interoperable emergency communications. P25 CAP provides a process through which equipment can demonstrate that it correctly follows the standard and is able to interoperate with other equipment following the standard. When interoperability testing is combined with conformance testing, the public safety community can be assured that equipment conforms to the standard and will interoperate with all compatible equipment that correctly implements the standard, including equipment that was not tested. Conformance testing helps provide increased confidence that equipment developed in the future will retain compatibility with legacy systems.

(4) One issue raised at the hearing was that some of the interoperability problems that have emerged were not due to a failure to conform or comply with the standard, but were due to configuration issues. Do you agree with this? What is the role of the of the P25 process and/or the federal government in ensuring that configuration issues do not hinder interoperability?

Response: Radio systems are complex and include many features and functions that need to be configured. The way a radio is programmed varies from manufacturer to manufacturer. When public safety practitioners respond to an emergency and attempt to use their own equipment to communicate with responders from different agencies they may be forced to reconfigure their radios. This effort can waste valuable time and expend limited resources during an emergency. Additionally, improperly configuring a radio can prevent interoperability. Configuration issues could be addressed either through the voluntary consensus process or directly by manufacturers.

To date, P25 has focused on standardizing interfaces instead of internal functions of equipment, such as the method for configuration. Communication standards focus primarily on standardizing the interfaces because that is critical to ensuring devices can communicate across manufacturers. Internal device functions allow for product differentiation and manufacturers are free to be innovative with their product as long as they correctly implement the interface, allowing for interoperability.

Question Submitted by Subcommittee Vice Chairman Luján

(1) I am glad to see that we are having this important discussion, and I look forward to working with you all and my colleagues on policy that supports effective, high-tech public safety equipment. As a border state, New Mexico is faced with unique public safety challenges. Can you elaborate on how interoperability can affect border security? How can we support interagency coordination as well as coordination with state and local governments on establishing interoperability standards and technology to assist border security efforts?

Response: Since its creation, the Office for Interoperability and Compatibility (OIC) has supported user driven processes such as P25. Recognizing the need for an open and transparent compliance process, OIC established a P25 Compliance Assessment Program Governing Board to represent the collective interests of organizations that procure P25 equipment. The Governing

Board consists of local, state, and Federal Government employees who are active in the operation or procurement of communication systems. Members of the Governing Board represent states and communities on the northern and southern border. Their input into the Governing Board helps ensure the work benefits interoperability on the border.

Questions Submitted by Congressman Peters

(1) First responders in Michigan and other border regions must be prepared to coordinate with foreign first responders should an emergency occur at border crossings. Has the effort to increase compliance and interoperability of public safety LMR systems included coordination with international entities, such as Canadian first responders and regulators?

Response: As part of its efforts to improve interoperability, the Office for Interoperability and Compatibility (OIC) is coordinating with responders from Canada. Representatives from OIC have participated in the Canadian Voice Interoperability Workshop to discuss the need to accelerate P25 standards and use a robust compliance process. Additionally, the P25 Compliance Assessment Program provides a universal method for testing for compliance to P25, which is used internationally.

(2) First responders in Michigan tell me that radio communication would be one of the most significant challenges in communicating with Canadian personnel in case of emergency and that they currently lack the capability to communicate in the event of a large scale disaster such as a tunnel failure or bridge sabotage at the border. Has there been any effort to develop or provide first responders at border regions with specialized shared radio units that would provide seamless cross border communication? Have government regulators worked with Canadian regulators to discuss how to create radios that would be interoperable and meet both countries' regulatory requirements?

Response: One of the goals of Office for Interoperability and Compatibility's (OIC) Multi-Band Radio (MBR) Project is the advancement of MBR technology to improve key communications between local, tribal, regional, state, and Federal agencies. To do this, OIC is collaborating with practitioners and industry to develop MBR technology that will enable a single radio to operate across disparate radio bands in use by the emergency response community in both the United States and Canada. OIC is funding the test and evaluation (T&E) of a single handheld MBR through three phases of pilot testing. Phase One involved T&E by U.S. and Canadian emergency response organizations along the Seattle/Blaine, WA border region and other Canadian emergency response agencies (e.g., Vancouver Transit Police) during the 2010 Olympics. During Phase Two, representatives of various emergency response disciplines in Michigan will use the MBRs, which have already been deployed and programmed. Upon the completion of full software development, OIC plans to conduct another pilot with cross-border potential in Phase Three with DHS's Customs and Border Protection in the Greater Detroit area. Pilot planning remains underway and is expected to include Canadian counterpart agencies. Additionally, OIC is collaborating with practitioners in Nogales, Arizona to conduct MBR T&E along the southwest border.

U.S. and Canadian regulators have a close working relationship and have worked together for many years to share radio spectrum along the border region. This is no simple task, as radio signals do not stop at the border and each nation has equal access to all radio spectrum. The State Departments of both Nations, the U.S. Federal Communications Commission, the National Telecommunications and Information Administration, and the Canadian spectrum regulatory body, Industry Canada, have all been actively engaged in solving regulatory issues, including the sharing of the radio spectrum along the border region.

Questions for the Record Submitted to:

Mr. Dereck Orr
Program Manager, Public Safety Communications Systems
National Institute of Standards and Technology

Question Submitted by Subcommittee Chairman Wu

(1) Acknowledging that P25 is a work in progress, at the end of his testimony, Dr. Hofmeister suggested that defining the standard functions and features included within a "package" may offer public safety a clearer picture of the functionality of the LMR systems they are choosing. What are your thoughts on this recommendation, or on other ways of providing agencies with a better window into the status of P25 and the implications the status may have on functionality?

Response: Public safety users today have great difficulty understanding what P25 is or means as they are procuring equipment. Part of that confusion stems from the fact that not all of the P25 interface standards are complete. Additionally, there is no set of standardized features required for a product to be labeled P25. The definition of a feature set required for the use of the P25 logo would give public safety increased confidence that a system labeled as P25 at least meets a minimum set of requirements and promotes interoperability.

Public safety users also benefit from the clear definition of each feature's completion status. With this information, public safety can determine which features of a system are truly standardized, and thus make better-informed procurement decisions.

In response to the absence of these initiatives within the P25 process, NIST and the Department of Homeland Security's (DHS) Office for Interoperability and Compatibility (OIC) have instituted the P25 Document Suite Reference (P25 DSR) and the P25 Compliance Assessment Program (P25 CAP). The P25 DSR identifies the current status of each of the five standards that make up the P25 interfaces. This information is updated following each P25 standards meeting, or faster as needs dictate. The P25 DSR can be found on the Public Safety Communications Research (PSCR) program's website (www.pscr.gov).

Addressing the lack of a standard feature set required for the use of the P25 label, NIST and the Department of Homeland Security launched the P25 Compliance Assessment Program, a voluntary program that allows P25 equipment suppliers to formally demonstrate their products' compliance with a select group of requirements by testing it in recognized labs. The output, Suppliers' Declarations of Compliance and Summary Test Reports, from the P25 CAP are available on DHS's Responders Knowledge Base website (www.rkb.us). All agencies (Federal, state, and local), however, have a unique set of requirements or operating conditions, and as such, each agency should require test information for those unique requirements, beyond those provided by the P25 CAP, during their procurement process (i.e., through Request for Proposals (RFPs), etc.).

(2) One issue raised at the hearing was that some of the interoperability problems that have emerged were not due to a failure to conform or comply with the standard, but were due to configuration issues. Do you agree with this? What is the role of the P25 process and/or the federal government in ensuring that configuration issues do not hinder interoperability?

Response: NIST does not know the degree to which configuration issues lead to radio problems in the field, but in our experience, the difficulty in configuring or programming a public safety radio, which varies from manufacturer to manufacturer, can be considerable. One variable that plays a large role in the complexity of radio configuration is the number of features incorporated into each radio. Additionally, each manufacturer has a different physical method of programming the radios along with a different software interface. In other words, there is no common method of configuring radios across multiple manufacturers.

This complexity, and the lack of a standardized method for programming radios across different vendors, can lead to operability and interoperability issues. However, in discussions with public safety organizations responsible for the provisioning of radios operating on a system, we have been informed that many of the issues found in the radios also require software upgrades to the radios themselves rather than a simple reconfiguration. Thus we are confident that some issues found in the field are due to problems beyond configuration and programming, and are instead due to non-conformance to the standard or problems with the standard itself.

That said, we do believe that configuration issues could become critical, hindering interoperability during an event where agencies from surrounding areas bring their own equipment into a response. If each radio used in an event requires configuration prior to use, and reconfiguration is complex and difficult, then the ability to communicate could become compromised.

If configuration issues are indeed contributing to interoperability issues, as has been identified by Mr. Hoffmeister, then it behooves those involved in the P25 process to address this issue given that the purpose of P25 is to standardize interfaces to facilitate interoperability.

Questions Submitted by Congressman Peters

(1) First responders in Michigan and other border regions must be prepared to coordinate with foreign first responders should an emergency occur at border crossings. Has the effort to increase compliance and interoperability of public safety LMR systems included coordination with international entities, such as Canadian first responders and regulators?

Response: Coordination among American and Canadian first responders is critical should an incident occur at the border. It is important that both American and Canadian public safety agencies are able to leverage P25 standards to increase confidence in interoperability among their systems. It is also important that PSCR and other Federal emergency communications agencies work closely with their Canadian counterparts.

For the last several years, PSCR staff have been invited to participate in the Canadian Voice Interoperability Workshop to speak on issues such as P25 and voice quality in land mobile radio systems. During these presentations, PSCR staff speaks to the status of P25 standards development and points out the fact that Canadian public safety agencies can also use the P25 CAP given the public distribution of the information. PSCR anticipates continuing its participation in such events as long as invited. In addition to direct participation in Canadian interoperability events, PSCR has committed to sharing all work product that can be shared publically with the Canadian first responder community.

In addition to this direct cooperation with Canada, other organizations are working directly on border interoperability issues with both Mexico and Canada. These organizations include the Department of Homeland Security's Office of Emergency Communications (OEC) and its Border Interoperability Demonstration Project as well as the National Public Safety Telecommunications Council's Border Issues Working Group.

(2) First responders in Michigan tell me that radio communication would be one of the most significant challenges in communicating with Canadian personnel in case of emergency and that they currently lack the capability to communicate in the event of a large scale disaster such as a tunnel failure or bridge sabotage at the border. Has there been any effort to develop or provide first responders at border regions with specialized shared radio units that would provide seamless cross border communications? Have government regulators worked with Canadian regulators to discuss how to create radios that would be interoperable and meet both countries' regulatory requirements?

Response: While PSCR works directly with the Canadian first responder community (through Industry Canada and the Canadian Interoperability Technology Interest Group), it does not work

with specific border agencies in either the US or Canada. Both DHS OEC and DHS OIC have direct relationships with their Canadian counterparts and are likely better informed to answer this question.

Questions for the Record Submitted to:

Mr. John Muench
Director of Business Development
Motorola

Questions Submitted by Subcommittee Chairman Wu

(1) One issue raised at the hearing was the difference between performing conformance testing while the product is in development and doing so after the product has been developed. Can you please comment on Mr. Orr's statement that testing during development meets conformance testing requirements if done with the "right" equipment and with a quality system in place? What is involved in developing the testing equipment and quality system?

Response: Any testing within the Department of Homeland Security (DHS) Compliance Assessment Program (CAP), be it Performance, Conformance or Interoperability testing, is required to be done in a lab that has been formally assessed by National Institute of Standards and Technology (NIST) and as a result, is formally recognized by the DHS CAP for specific types of testing, such as Conformance testing. The formal assessment of the lab includes providing the assessment team with Lab Management and Lab Quality manuals. These describe the management and quality practices of the lab. According to the NIST Handbook on CAP Lab Assessment, the assessment does not concern itself with the maturity of or adequacy of these practices. Instead, the assessment only ensures that evidence exists that these practices are documented by the lab and followed by the lab.

Mr. Orr's statement is based on an observation that conformance testing may occur in a recognized lab that is dedicated to DHS CAP testing or that conformance testing may occur in a manufacturer's "development" lab that is not dedicated to DHS CAP testing. Note that some types of conformance tests are intrusive to the physical product and so, it may be more practical to execute such tests in a product development lab that essentially "opens up" the equipment under test.

Mr. Orr's statement about "a quality system in place" means that if conformance testing is to be done in a development lab that is not dedicated to DHS CAP testing, the management and quality practices of that lab must meet the expectations of the NIST Handbook on CAP Lab Assessment in order for the development lab's test results to be accepted by the DHS CAP.

The nature of conformance testing is validation that the standardized messages are sent under specified conditions and that when standardized messages are received, the resulting reaction to the standard message content is as specified. Conformance tests require validation of specified stimulus conditions, specified message content and specified reaction to the message content. This requires test equipment that can capture messages exchanged, and display the message sequence and content.

The NIST Handbook for Lab Assessment identifies four categories of test equipment that may be used by a recognized lab for DHS CAP testing. For each category, the Handbook also identifies certain requirements for each category of equipment. During assessment, the lab is required to provide evidence supporting the categorization of the equipment to be used and to provide evidence that the equipment is meeting the requirements specific to that categorization.

Mr. Orr's statement about "done with the "right" equipment" means that the equipment used to produce the test results has been assessed and approved during lab assessment.

The quality system is a document describing the policies and practices of the lab intended to produce quality results. This documentation also typically describes how these policies and practices will be monitored and enforced. This documentation is created and maintained by the management of the lab and provided to the assessors during NIST lab assessment.

As previously noted, the NIST Handbook on Lab Assessment identifies 4 categories of test equipment:

- Commercial Off the Shelf (COTS) test tools - Test equipment is not modified in any way after purchase and prior to use.
- Modified Off the Shelf (MOTS) test tools - Test equipment is modified to some extend after purchase and prior to use.
- Custom test tools- Test equipment is not commercially available and is custom made for specific use.
- Open Source/Freeware test tools - Test equipment is available to the general public under an open source license agreement and is not modified prior to use.

Only test equipment falling into the "MOTS" or "Custom" categories requires any sort of development. In these cases, the developer determines the requirements for the test equipment imposed by the test methodology and using a documented design and development process, builds or modifies the equipment capabilities to meet the requirements of the test methodology. Once the custom or modified capabilities have been implemented, per the documented design and development processes, these capabilities are validated the against the design requirements prior to actual use.

(2) Acknowledging that P25 is a work in progress, at the end of his testimony, Dr. Hofmeister suggested that defining the standard functions included within a "package" may offer public safety a clearer picture of the functionality of the system they are buying. What are your thoughts on this recommendation, or other ways of better communicating the status of P25 to purchasers

Response: The reality of the P25 market is for P25 compliant products to be designed and manufactured for flexibility in order to meet the diverse mission needs of the users. Standardized packaging of P25 features is something that can be done, but in my opinion will not ultimately satisfy the end user requirement for better information on the status of P25.

Public Safety Practioners commonly ask for Project 25 status and feature information as outlined by these four questions:

1. What features are in P25?
2. Where can a definition for these features be found?
3. What features have been implemented by a manufacturer?
4. What features have been tested for multi-manufacturer interoperability?

The answers to four questions help them determine, what set of P25 features meet their specific communications needs, which manufacturers provide the desired set of P25 features that meet their specific needs and whether the desired P25 feature set has been successfully tested for interoperability with the desired manufacturers.

The answers to the first two questions can be found in the P25 Statement of Requirements document published by the P25 User Needs Subcommittee and in TIA-102 Standard documents. The Public Safety Practioners develop and publish the "P25 Statement of Requirements" themselves. Public Safety Practioners receive free access to the published TIA-102 Standard

documents through a special TIA web access. Normally, the TIA Standard documents have to be purchased.

Each manufacturer markets the information as to what features and functions their company has implemented in their product lines. Among the supported features and functions are those claimed to be compliant to the Project 25 standard. If this information is not readily available, purchasers can get insight as to which P25 features have been implemented by a manufacturer by issuing either a Request for Information or a Request For Proposal.

Information on which features and functionality have been tested for interoperability and between which manufacturers, has not been publicly available in the past. The driving force for formal interoperability testing is the DHS grant monies. The grant guidance outlines a requirement for manufacturers to produce a P25 Suppliers Declaration of Compliance (SDoC) and Summary Test Report (STR). These documents include the results of formal interoperability testing. Purchasers can obtain information describing what P25 functionality has been tested by which manufacturers by requesting SDoC/STRs from the manufacturers or obtaining them from the Responder Knowledge Base (RKB) website.

The P25 Standard will never be comparable to the 3G/4G or WIMAX standards when it comes to public recognition or when a user is looking for information. The P25 manufacturers are not selling equipment to multiple global cellular service companies--each with massive marketing departments, operating worldwide cellular networks. P25 manufacturers are not shipping hundreds of millions of hand held radios every year.

The P25 manufacturers sell products to a unique marketplace that values products based on the Project 25 standard and implemented to provide guaranteed performance, long-term durability, security and features necessary for mission critical communications. Project 25 actively involves and uses the input of Public Safety Practioners (Police, Fire, EMS personnel, as well as State, Local and Federal agencies) when determining the needs and the scope of the P25 standard. Public Safety Practioners are members of P25 committees, they can submit comments on draft P25 standard documents and they can attend meetings in person and on conference calls. They are free to comment on the priorities of the P25 standard. Public Safety Practioners have always been involved with the development of the P25 Standard. Although the P25 market is smaller, the involvement of the user community in the standard development enables an informed user community without the massive marketing departments like the cellular marketplace.

There have been discussions within P25 about structuring specific features into packages to make ordering easier with the assumption that this would make it easier for the purchaser to understand what he is purchasing.. One of the challenges of offering pre-packaged P25 features for ‘mission critical’ communications equipment and systems is that the size, mission and communication needs of public safety agencies vary dramatically. It is this variation that limits the value and utility of standardized feature packages.

The size of a public safety agency can vary from 6 officers to over 35,000 officers; who serve populations from a few thousand to a few million. This size variation impacts the features needed and how the system operates. The different communication needs of the fire fighter all geared-up with breathing masks at the fireground, the metropolitan patrol police officer walking a beat, the state trooper patrolling the highways at high and slow speeds, federal law enforcement patrolling remote borders and the military communicating at forts and bases require different communication features and operations. The frequency bands in which these agencies operate are different, with different FCC and NTIA licensing requirements that directly impact the design and operation of the equipment and system. These public safety practioners use some of the same P25 services and features but may also require services and features with special behaviors, or various combinations of features, services and accessories that make their operations unique. For example, federal law enforcement using P25 equipment have wireless security requirements that are not imposed on state and local users.

Motorola does not envision a future where there is just one model of a P25 radio, nor should there be a P25 radio limited to only the P25 features fully-defined by published P25 standards. Today, there are many radio models and configurations that are P25-complaint and also support other standards or proprietary operations. Manufacturers offer product tiers at different price points and are free to configure feature sets to meet particular marketplaces. A manufacturer offers feature variations that are marketed to meet the individual business opportunities for that manufacturer. Customers continue to request features for their equipment that are not part of P25.

It has been Motorola's experience that purchasers of P25 equipment are most concerned with the status of multi-manufacturer interoperability. Aside from having a defined TIA Standard, P25 purchasers want to know what features, with what P25 portable and mobile radios, are interchangeable with what P25 fixed radio systems. The only action that resolves this concern is documented interoperability testing. The faster more features are added to the P25 CAP interoperability test suites, the faster users will know the interoperability status of products that can meet their feature needs. The P25 CAP could be expanded to cover more features faster, if the expansion first focused on interoperability testing of functionally-defined features with follow-on testing expansion to include conformance testing of these same features. The current P25 CAP testing approach is more vertical in nature. The current approach defines conformance and interoperability testing feature by feature. This provides a complete testing profile by feature but slows the initial interoperability testing for all features. Conformance testing is part of P25, but it is not a substitute for interoperability testing.

Also, the current 'rule of 3' for posting interoperability testing maybe keeping some vendors from posting interoperability performance status on the RKB. The 'rule of three' requires that the P25 equipment from one vendor be interoperability tested with three P25 equipment vendors. It is difficult, and can take many calendar months, for multiple manufacturers to schedule interoperability testing considering the multiple product development schedules of P25 manufacturers. Motorola would suggest that the 'rule of 3' for posting interoperability testing results be relaxed, allowing posting results with just one other manufacturer, but maintaining the 'rule of 3' for equipment to be eligible for DHS grant monies.

Questions for the Record Submitted to:

Dr. Ernie Hofmeister
Senior Scientist
Harris Corporation

Questions Submitted by Subcommittee Chairman Wu

(1) At the end of your testimony you suggested that "there could be much progress is making sure that you define what those levels of [baseline and above] of interoperability are and make sure those are present, tested for and present in every product." What would be required to implement this type of product labeling?

Response: The intent of this comment was to reference one of the Harris recommendations in the written testimony that: "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." Within the P25 suite of standards, there

is an array of mandatory and standard option features.[15] As the name implies, mandatory features are those features that must be included in every P25 radio and system product. For example, Unaddressed Voice Call is a mandatory feature for the conventional mode of operation and Group Call Voice is a mandatory feature for the trunked mode of operation. For the current published suite of P25 standards, there are approximately 10 mandatory conventional features and 13 mandatory trunked features. However, for standard option features, there are approximately 30 standard option conventional features and 34 standard option trunked features. A standard option feature is a feature that the user has the option of purchasing/deploying and the manufacturer has the option of providing in its P25 radio and system product. With the 10-13 mandatory features representing the most basic level of operation and the 30-34 standard option features variably implemented in public safety P25 systems according to the buying needs/requirements of the user and the manufacturers option to provide, the range of P25 features varies significantly from P25 system to P25 system. The reason for the relatively large number of standard option features is to allow flexibility for various size public safety agencies to implement systems with capability scaled to their needs from relatively small, lower capability to very large, high capability needs. While such flexibility is good to allow adaption to user needs, it does create challenges when attempting to define one or more standard interoperability profiles (levels of capability) that can be tested and practiced with high assurance that the needed interoperability will work well when needed.

It is Harris' view that with such variability and flexibility in P25 features supported, interoperability in terms of features/capability means something quite different from public safety agency to public safety agency and especially from smaller, more likely rural agencies to larger, more likely metropolitan agencies. As noted in the Harris written testimony, "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." A similar grouping or packaging of features into levels or profiles of interoperability would reduce the large variability in terms of interoperability features supported to a reduced set levels or profiles. Such grouping of interoperability capability features would make specification, testing, and marking of interoperability capability simpler, more efficient, and adaptable to the interoperability needs of various public safety agencies.

Harris views that the steps needed to implement such a specification, testing, and marking of interoperability levels or profiles would include:

a. P25 knowledgeable public safety agencies working together for consensus to define the P25 features for several levels of interoperability capability. These levels or profiles could include: P25 Interoperability Capability 0 (baseline and probably just the mandatory features); P25 Capability 1 (Capability 0 plus more features); P25 Capability 2 (Capability 1 plus more features), etc. Harris would envision that there should be five or fewer capability levels.

[15] The official definitions of mandatory and standard option features are included in the Project 25 Statement of Requirements (P25 SoR, Mar 3, 2010 Approved Version) as:

- A Mandatory service, feature, or capability supported by the suite of P25 standards is to be supported by all P25 systems. Implementation of the so-designated services, features, or capabilities shall comply with the P25 standards defined by TIA.
- Likewise, a Standard Option service, feature, or capability is supported by the suite of P25 standards. The user has the option of deploying so designated services, features, or capabilities. Likewise, manufacturers have the option of offering so designated services, features, or capabilities. If deployed in a particular P25 system, implementation of the Standard Option shall comply with the P25 standards defined by TIA.

b. Once the Capability Levels are defined in item a, the P25 community (industry and users) would select or develop the interoperability test standards corresponding to the features specified in the Capability Levels. This could be a selection of a subset of tests in the current trunked voice interoperability and the conventional voice interoperability standards. For the higher level(s) of interoperability, it may be necessary to develop supplemental interoperability tests for the standards.
c. The results of item b could be provided to the P25 Compliance Assessment Program Governing Board for their consideration to incorporate into the formal P25 Compliance Assessment Program interoperability tests through a Compliance Assessment Bulletin (CAB).
d. The current or additional Recognized P25 Compliance Assessment Laboratories could be assessed as necessary and recognized for these Interoperability Capability Levels.
e. Manufacturer's products could then be tested in the P25 CAP Recognized Laboratories per the CAB.
f. Based on the results of the P25 CAP interoperability testing, the posted Summary Test Reports (STRs) and the Supplier's Declaration of Compliance (SDoCs) could reflect the Interoperability Capability Level(s) passed.
g. If desired, a suitable P25 Interoperability Capability Level sticker or marker could be developed and used to visually show the P25 Interoperability Capability Level of the subject P25 product.

This approach could be consistent with the testimony during the Hearing of Dr. Boyd, "The way we talk about standards is that there ought to be some core set of functionalities that we make sure remain in place. …. I think the manufacturers are working very closely with us to develop that core set of functionalities."[16]

(2) One issue raised at the hearing was the difference between performing conformance testing while the product is in development and doing so after the product has been developed. Can you please comment on Mr. Orr's statement that testing during development meets conformance testing requirements if done with the "right" equipment and with a quality system in place? What is involved in developing the testing equipment and quality system?

Response: As a preface before answering the question and specifically on ISSI conformance testing, Harris views ISSI conformance testing as a design verification method used on software subsystems during product development in engineering laboratories. Harris does conformance testing as part of product development in engineering laboratories and at various stages of development (e.g., unit test, integration test, and SVT) to verify subsystem design. The testing is less formal, but done. In general, Harris does not feel that repeating conformance tests on a formal basis after complete product development adds significant value compared to the effort required. Harris is on public record several times in comments[17,18] to the P25 CAP Governing Board regarding its position on formal P25 CAP ISSI conformance testing. That being said, Harris recognizes that the P25 CAP Governing Board issued a P25 CAP ISSI Compliance Assessment Bulletin (CAB) that specifies approximately 30 conformance and 27 interoperability tests and that this CAB is in effect.[19]

In terms of answering the question, Harris agrees with Mr. Orr's statement that there is a provision in the P25 Compliance Assessment Laboratory guidelines that would allow "recognized" conformance testing during product development if done with the "right" equipment and quality

[16] From 5.27 hearing transcript for Dr. Boyd statements at lines 874 and 883.
[17] Harris Comments on DHS OIC P25-CAB_ISSI_REQ—December 2009, Ernest L. Hofmeister, Harris Corporation, January 18, 2010.
[18] Harris Comments to DHS P25 CAP Governing Board – March 31, 2010, Ernest L. Hofmeister, Harris Corporation.
[19] P25 Compliance Assessment Bulletin, Baseline Inter-RF Sub-System Interface Testing Requirements, P25-CAB-ISSI_TEST_REQ, Office for Interoperability and Compatibility, US DHS, March 2010.

system in place. The Guide[20] "discusses an approach of integrating recognized P25 CAP compliance test activities with the Product Development organization design validation testing activities. However, in order for this integrated approach to be successful, the recognized P25 CAP laboratory and product development must ensure that the provisions of NIST Handbook 153[21] are completely satisfied."

While Harris continues to evaluate the integrated approach, Harris is concerned about the operational practicality of integrating the product development environment into the P25 Compliance Assessment Lab environment in compliance with the Guide and NIST Handbook 153 and the business investment impact to do so. The practicality and investment challenges include establishing the "right" test equipment (including software test tools) and the quality system per NIST Handbook 153.

a. "Right" Test Equipment

Regarding the "right" test equipment, for conformance testing for interfaces like the Common Air Interface (CAI) where commercial off-the-shelf test equipment like protocol analyzers and RF test equipment exists that can be readily validated per NIST Handbook 153, establishing the "right" test equipment is not a challenge. However, for conformance testing for interfaces like the Intra-RF SubSystem Interface (ISSI) where the ISSI product is primarily software and where commercial off-the-shelf software test tools that can be readily validated per NIST Handbook 153 do not exist, establishing the "right" test equipment is a significant challenge. Conformance testing for software products like the ISSI by its nature is tedious and labor intensive without some automated and validated test tool. Harris is not aware of such a tool, but maintains a high interest level in sources or information on such a tool. An R&D version of an automated tool has been offered by NIST, but it has not been validated to our knowledge and especially not per the NIST Handbook 153 requirements for software test tools. Similarly, an ISSI software test tool offered a small company, Valid8, has been evaluated by Harris. Our assessment is that while this tool is promising for the future, a sizeable amount of continued development, maturation, and validation would be required before it could be considered a "right" test tool. Harris and industry experience with software and products from R&D labs and small companies is that much effort is often required to finish the development to a product and to validate and then to support.

Harris also notes that formal ISSI conformance testing will likely not be a one-time event where tedious, labor intensive testing might be more supportable. As with many complex P25 products, Harris expects that ISSI product releases will occur over time with successive releases supporting more and more of the ISSI features. ISSI conformance testing would be required for each successive ISSI product release.

Harris cannot afford to be both an LMR P25 equipment manufacturer and a test equipment/tool manufacturer. The public safety LMR P25 industry is just not like the cellular industry where we understand formal conformance tests are done. The much higher product mix and the much, much smaller volumes means that Harris, and likely the industry, must do things differently than the cellular industry. The orders of magnitude difference in scale between the LMR P25 industry and the cellular industry was identified and discussed during the hearing.

Thus, for ISSI conformance testing, the lack of a validated, automated software test tool ("right" equipment) represents a significant practical technical and business investment challenge. This challenge applies independent of whether the formal conformance testing is integrated with

[20] P25 CAP Laboratory Testing: Guide for Integration With Product Development Organizations, issued by P25 CAP, June 26, 2009, file Integration of P25 lab testing with product development r10.pdf.
[21] NIST Handbook 153, 2009REV Edition, ―Laboratory Recognition Process for Project 25 Compliance Assessment,‖ Kurt B. Fischer and Andrew Thiessen, Editors, Office of Law Enforcement Standards, Electronics and Electrical Engineering Laboratory, National Institute of Standards and Technology, U.S. Department of Commerce, June 2009.

product development or whether it is done separate from product development after the product is complete in a recognized P25 CAP lab. Development and validation of an automated ISSI conformance test tool by the Public Safety Communications Research (PSCR)[22] program (or another NIST/OLES or NTIA/ITS) group or validation of a 3rd party tool by PSCR for use by industry is an area where the DHS (or PSCR, NIST/OLES, NTIA/ITS) could make a significant contribution toward reducing the burden on the small P25 industry consistent with their intent indicated in the statements of Mr. Orr during the hearing.[23] A rough order of magnitude (ROM) estimate for Harris to develop and validate an automated ISSI test tool is $1.4 MUSD with a recurring expense of about 10% to maintain the tool. This amount represents a substantial portion of the R&D cost to develop the ISSI product itself. In the resource constrained R&D environment, development of an automated ISSI test tool by Harris would require diverting critical software engineering resources from ISSI product development to test tool development. The result would affect Harris' ability to compete in the marketplace through reduced ISSI product innovation and longer time to market for ISSI features in order to implement formal ISSI conformance tests. Such an investment and diversion of resources would not be justified or acceptable for normal business considerations and practices and especially for the formal testing that Harris believes provides little added value or compliance assurance beyond that already provided by the normal in-formal conformance testing as part of product development.

b. Operational Practicality and Quality System

Harris understands the need for the rigor and careful formal control in the P25 CAP as defined in the Guide and NIST Handbook 153 for such testing to be recognized by DHS/NIST. While not impossible, the rigor and careful formal control is more challenging to implement for the case where the product development environment is integrated with the separate P25 CAP lab environment than when the P25 CAP lab is maintained as a separate and self-sustaining environment.

For Harris, the Product Development environment, while controlled, is very dynamic, flexible, fast-paced, and less formal with hardware and especially software changes rapidly implemented, tested, and revised leading to a final hardware and software configuration. The final hardware and software configuration is then released to the System Verification & Test (SVT) environment within the Product Integrity organization for more rigorous, controlled, and formal product and system verification testing. There is interaction and iteration between the SVT and product development groups for items found in SVT testing that could be problems or unexplained behavior leading to a final version of hardware and software that is releasable for products and systems. The SVT testing often extends over a period of months and usually includes Beta testing at one or more customer installations. Harris has formal product releases indicated as PR-AB-C and system releases indicated as SR-DE-F.

Establishing a Quality Management System for integrating elements of the product development and SVT environments into the Harris P25 CAP lab environment can be done with suitable effort, care, and due diligence. The challenge Harris sees is the operational practicality of the integrated environments. The concern is the coordination and interruption of the flow and interaction of the normal activities in the product development and SVT environments to accomplish the P25 CAP conformance testing. Repeated interruptions for P25 CAP conformance testing for the various

[22] Per Mr. Orr's written testimony for this hearing, "The PSCR program serves as the technical lead for several Administration initiatives focusing on public safety communications, most importantly the Department of Homeland Security's (DHS) Office for Interoperability and Compatibility (OIC) within the Science and Technology Directorate." For more information on PSCR see the website: http://www.pscr.gov.

[23] Mr. Orr's statement starting at line 1201 of the 5.27 hearing transcript: "We realize that any additional testing that is placed on industry is going to cost money and so we have done everything within this program to ensure that we are minimizing the burden on industry, minimizing the financial requirements that are needed to put the program in place"….

near-final versions of software before final release could have an undesired impact on the product and system software release schedule. While still under evaluation, Harris, at this point, would likely favor performing the P25 CAP conformance testing after the product has been developed and ready for release in the separate P25 CAP lab environment. An earlier concern about CAP testing of the final product because some P25 CAP conformance tests are invasive and require special software test code that would undesirably reside in the final product has been alleviated. The recent practice in the TIA-P25 and NIST/OLES groups has been to not include any invasive tests in the P25 CAP.

c. Harris Summary and Business Perspective for P25 CAP ISSI Conformance Testing

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 agrees with Mr. Orr's statement that there is a provision in the P25 Compliance Assessment Laboratory guidelines that would allow "recognized" conformance testing during product development if done with the "right" equipment and quality system in place. The Guide6 "discusses an approach of integrating recognized P25 CAP compliance test activities with the Product Development organization design validation testing activities." While Harris continues to evaluate the integrated approach, Harris is concerned about the operational practicality of integrating the product development environment into the P25 Compliance Assessment Lab environment in compliance with the Guide and NIST Handbook 153 and the business investment impact to do so. The practicality and investment challenges include establishing the "right" test equipment (including software test tools) and the quality system per NIST Handbook 153. Regarding the "right" test equipment, for conformance testing for interfaces like the Common Air Interface (CAI) where commercial off-the-shelf test equipment like protocol analyzers and RF test equipment exists that can be readily validated per NIST Handbook 153, establishing the "right" test equipment is not a challenge. However, for conformance testing for interfaces like the Intra-RF SubSystem Interface (ISSI) where the ISSI product is primarily software and where commercial off-the-shelf software test tools that can be readily validated per NIST Handbook 153 do not exist, establishing the "right" test equipment is a significant challenge. Establishing a Quality Management System for integrating elements of the product development and SVT environments into the Harris P25 CAP lab environment can be done with suitable effort, care, and due diligence. The challenge Harris sees is the operational practicality of the integrated environments. The concern is the coordination and interruption of the flow and interaction of the normal activities in the product development and SVT environments to accomplish the P25 CAP conformance testing. Harris, at this point, would likely favor performing the P25 CAP conformance testing after the product has been developed and ready for release in the separate P25 CAP lab environment.

In terms of a Business perspective to establish and maintain a recognized P25 CAP ISSI conformance testing laboratory, Harris has conducted a ROM scoping analysis of the total ISSI market and the investment to establish and maintain a recognized P25 CAP ISSI conformance testing laboratory. The ROM scope investment to establish and maintain a recognized P25 CAP ISSI conformance testing laboratory ranges from a substantial portion of the total estimated annual ISSI market to several times the total estimated annual ISSI market. The range corresponds to the situations of establishing and maintaining a recognized laboratory integrated with the product development environment and establishing and maintaining a recognized laboratory separate from the product development environment. Such an investment for either situation would not be justified or acceptable for normal business considerations and practices and especially for testing that Harris believes provides little added value or assurance beyond that already provided by the normal conformance testing as part of product development. Harris believes that a validated 3rd party automated ISSI conformance software test tool as a minimum and likely a 3rd party recognized P25 CAP lab for ISSI conformance testing are critical for the practical implementation of formal ISSI conformance testing per the P25 ISSI CAB in effect and cited earlier. Development and validation of an automated ISSI conformance test tool by the Public Safety Communications Research (PSCR)[8] program (or another NIST/OLES or NTIA/ITS) group or validation of a 3rd

party tool by PSCR for use by industry is an area where the DHS (or PSCR, NIST/OLES, NTIA/ITS) could make a significant contribution toward reducing the burden on the small P25 industry consistent with their intent indicated in the statements of Mr. Orr during the hearing.[9]

Additional Comments

Harris offers the following additional comments to clarify certain areas brought out during the course of the hearing:

P25 Equipment Interoperability:

It was implied that not all P25 certified (vendor self-certification) equipment can interoperate. An example was given where you have three P25 radios from different systems and only two could talk to each other. Harris believes that this is not the norm and that the status of interoperability among P25 equipment from various vendors is very good and we testified to that fact. Land Mobile Radio systems are complex and one could say that each system deployed is custom to that user. This presents challenges in how a particular system is configured. We have testified that many times inconsistencies are a result of how a radio system is configured versus whether or not the equipment meets the standard. We should also point out that currently P25 systems of one frequency can not interoperate with P25 systems of a different frequency regardless of whether they pass testing. This is being addressed by the in-place ISSI standard.

Completion Status of P25 Standards:

In the context of the hearing subject, "Interoperability in Public Safety Communications Equipment," Harris believes it is important to state the completion status in terms of the interfaces that are critical and fundamental to system and equipment interoperability. Harris agrees with Dr. Boyd's DHS S&T testimony that the CAI (conventional and trunked) and the ISSI are the interfaces critical and fundamental to system and equipment interoperability. Per Mr. Orr's PSCS testimony, "To date, only the conventional portion of the CAI and the Inter-RF-Subsystem Interface have a completed suite of documents as defined above. The more complex trunked CAI continues to lack conformance test documents (crucial for uniform implementation) although trunked CAI products have been sold for almost a decade." From this view and using the five standards documents per interface for completion per the Mr. Orr written testimony, the P25 standards completion status for the interfaces critical and fundamental to system and equipment interoperability is pretty solid:

- Conventional CAI – 5 of 5 documents complete – 100% Complete
- Trunked CAI – 4 of 5 documents complete with conformance to be completed – 80 % Complete
- ISSI – 5 of 5 documents complete – 100% Complete.

For this analysis, 14 of 15 standards documents are complete; i.e., 93 % Complete.

In addition, for the trunked CAI interoperability as reported in the Harris written testimony, multiple 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 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) and Summary Test Reports (STRs) posted to the official RKB website for information and review by public safety agencies and practitioners. To have passed the trunked voice interoperability standard for these tests, each P25 radio needed to pass 20 tests in the standard on at least three different manufacturer's system infrastructure. It is for these reasons of standards completion status above and the cited trunked interoperability testing results that Harris stated in its testimony that the P25 product standards, the testing standards, and the product features are in place or soon will be in place to enable a solid level of P25 trunked and conventional systems interoperability.

Standards pace is at full industry support capacity:

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. Harris believes that since 2005, the standards pace is at full industry/user support capacity. As a rough estimate, there are less than 25 top engineers in this industry with the knowledge, perspective, and capability to develop credible Project 25 standards. Since 2005, there have been approximately 23 week-long, face-to-face TIA & P25 meetings with over 40 working attendees per meeting amounting to ~37,000 person hours or over 23 person years. In addition, there have been over 10 hours of subcommittee or task group conference calls per week over this period with over 10 people participating amounting to ~ 28000 person hours or over 17 person years. In addition, the preparation time of technical document contributions is done outside of the conference call and meeting time. Since 2005 over 13,000 contributions toward the TIA-P25 suite of standards have been submitted for review, critique, and edit. Without researching the TIA records for years 2005-2007, over 75 documents have been formally balloted as a standards documents and over 60 documents have been published as TIA-P25 standards in the 2 ½ years since 2008 through the present time in 2010. Hence, the Harris view that the standards pace is at full industry/user support capacity.

On-site Compliance Assessment Labs:

There was testimony about voluntary testing programs for P25 systems. Both Harris and Motorola testified to the fact that they both have established Compliance Assessment Laboratories and have hosted multiple vendors. Harris testified that it has invested significant resources in support of the P25 standards process. We should highlight that in addition to time, personnel and the costs associated with these standards activities, Harris spent close to $2M to establish an in-house test capability including capital and operating/development costs. It is in the vendor's best interest to deploy compliant equipment. As Chief Johnson testified, most systems are procured through a process that ensures that all equipment is operational before the system is approved for first responder use. Established testing paired with the strict requirements of the procurement process ensures positive results.

As noted during Harris' oral testimony, the P25 industry is small by comparison to the commercial industries of cellular, WiFi, and Bluetooth mentioned by Mr. Orr in his written and oral testimony. To illustrate the total 2009 North American Land Mobile Radio market is estimated to support 12 million users of which 4 million represent public safety users. The P25 industry is estimated to be about half of the total with about 1.5 million users. In contrast, the total 2009 US cellular market is estimated to support about 270 million users/subscribers. The P25 market is about 0.5% of the commercial users/subscribers. Given the scale difference of the P25 industry with a commercial industry like cellular, Harris believes that comparisons and expectations for the P25 industry in terms of the rate of standards development and industry-led compliance assessment are not relevant.

Beyond P25:

Complete ubiquitous interoperability among existing narrowband LMR systems will not be achieved through deployment of P25 equipment alone. As Dr. Boyd testified, public safety has an installed base of radio systems equal to approximately $100 Billion. These systems are of varying ages, operating frequencies, mode, etc…. Other than cost, there are many considerations when procuring a radio system; some of which are size, use, geography, spectrum availability, future proof, etc… There are smaller, rural entities today that do not have the funds to upgrade to an expensive digital system yet may be the central site of a manmade or natural disaster and will need to interoperate with other first and second responders during an incident. To address the unique needs of public safety entities and to achieve varying levels of interoperability, vendors provide a wide array of products from P25 radios and infrastructure to Internet Protocol (IP) networks that connect disparate systems through standardized network architecture.