



Saving Lives and Property Through Improved Interoperability

***Post-Symposium Support Report—
PSWN Program and NTIA Conference***

Final

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Current and Emerging Solutions to Public Safety Communications Interoperability Conference

Creating New Opportunities with Technology

The Public Safety Wireless Network (PSWN) Program and the National Telecommunications and Information Administration (NTIA) jointly hosted the Current and Emerging Solutions to Public Safety Communications Interoperability Summit in Washington, D.C., on June 11–12, 2002. The conference, which was a first of its kind, brought together nearly 80 high-level government officials with more than 20 public safety vendor representatives to discuss solutions for improving public safety wireless interoperability. The two-day conference was composed of panels and group discussions addressing many of the technical, political, and financial issues challenging interoperability today.

Public Safety Interoperability Challenges

Ms. Nancy J. Victory, Assistant Secretary of the Department of Commerce and Administrator of NTIA, opened the conference with a keynote address (see <http://www.ntia.doc.gov/ntiahome/speeches/2002/pubsafety6112002.htm> for a complete transcript). In her remarks, Ms. Victory emphasized that while public safety interoperability was a priority for the Bush Administration, addressing the issue was, in large part, in the hands of state and local leaders. She added that wireless technology vendors also played a key role as developers of technologies to meet the communications and interoperability demands of the public safety community.

Ms. Victory provided an update on some of the more important spectrum and technology issues impacting public safety today. These issues included the allocation of spectrum in the 700 and 800 megahertz (MHz) bands and new spectrum allocations for third generation (3G) wireless technologies. The following summarizes her comments —

- The Administration has called for postponing the 700 MHz auction because of the uncertainty concerning how incumbent broadcast television providers will clear the band.
- FCC officials are now evaluating a spectrum allocation plan for the 800 MHz band and beginning to address public safety needs and interference issues.
- NTIA and FCC officials are conducting a viability assessment of spectrum in the 1.7 and 2.1 gigahertz (GHz) bands, both of which are currently used for critical defense systems and for 3G commercial wireless technology services.

In addition to these issues, Ms. Victory commented that the outcome of the Bush Administration's Department of Homeland Security proposal could not currently be determined. She indicated that NTIA supported the proposal and hoped that it would continue to elevate the issue of public safety communications interoperability as a national priority and enhance interagency coordination.

The September 11 terrorist attacks significantly changed the way the Nation perceives public safety services; however, no major advancements in public safety interoperability have occurred since then. The numerous and complex challenges hindering interoperability have most likely contributed to this delayed response.

Mr. Bob Lee, PSWN Program Manager from the Department of Justice (DOJ), provided an overview of the critical challenges to improving interoperability. He explained that for the most part, such challenges were deeply entrenched, shaped by a long history of “stovepipe” system development characterized by proprietary technologies, varying public safety frequencies, and an insular approach to system implementation. In fact, as noted by Mr. Jay Herther of M/A-COM, when one considered the 13 different public safety frequency bands, varying signal processing techniques, and proprietary trunking technologies, there are roughly 260 permutations of public safety radios in use today.

Current Interoperability Solutions

Given such variety in radio technology, interoperability solutions must be tailored to best meet the specific needs of the agencies involved. Mr. Rick Murphy, PSWN Program Manager from the Department of the Treasury (Treasury), provided insight into the pros and cons of several common technical interoperability solutions. These characteristics are captured in Table 1.

Table 1
Pros and Cons for Common Interoperability Solutions

Interoperability Solution	Relative Ease of Implementation	Requirement for Additional Resources	Relative Security Afforded	Relative Cost
Audio Switch	Low	High	Medium	High
Console-to-Console Patch	Medium	Medium	High	Low
Proprietary System Interconnect	Medium	Medium	High	Medium
Cross-band Repeater	High	Medium	Low	Low

Mr. Murphy also discussed some of the more notable regional interoperability solutions. The following speakers provided in-depth looks into their efforts to use current technology—

- Mr. Tim Quinn, U.S. Forest Service, of the *Service First* initiative, which has improved interoperability among U.S. Forest Service and Bureau of Land Management personnel operating in national forests in Colorado, South Dakota, and Wyoming by consolidating and simultaneously upgrading the land mobile radio (LMR) resources of both agencies
- Mr. Curt Munro of the *Regional Communications System*, which covers both San Diego and Imperial counties in southern California and provides interoperable communications among participating agencies that collectively incorporate more than 16,000 public safety personnel

- Lieutenant Gilbert Thomas of the *Miami–Dade County Police Department*, which has worked with other agencies to connect disparate communications systems used by more than 40 local, state, and federal agencies operating in south Florida
- Mr. Bill Phillips of the *Phoenix–Mesa Project*, which is currently implementing Project 25 (P25) compliant, shared citywide public safety systems in both Phoenix and Mesa and providing interoperability for public safety personnel in both cities.

Speakers provided detailed accounts of the more prevalent interoperability obstacles they confronted and best practices on how to overcome such challenges. The following table describes three common best practices underlying all three efforts.

Table 2
Best Practices for Implementing Interoperability Solutions

Best Practice	Approaches
<i>Build and sustain partnerships among several agencies and entities</i>	<ul style="list-style-type: none"> • Develop overarching memoranda of understanding or similar interagency agreements early in the process to clarify purpose, commit resources, designate operational frequencies, and provide ongoing technical services • Implement technologies or systems even if all agencies are not yet on board—“build it and they will come” • Form a central coordinating committee, such as a board of directors, that represents participating entities and makes executive-level decisions
<i>Integrate interoperability into operational procedures</i>	<ul style="list-style-type: none"> • Develop common terminology agreed to by agency dispatchers and radio technicians to overcome the turf issues among these personnel • Test interoperability interfaces (for connections between systems) at least once daily • Train incident command personnel on how to best leverage interoperable connections for improving incident command • Train field personnel on communications protocols relating to interagency communications • Integrate interoperable communications capacity into task force planning
<i>Implement reliable technology for interoperability</i>	<ul style="list-style-type: none"> • Conduct proof-of-concept tests with prospective vendors that evaluate technology using pass/fail criteria based on specific needs • Develop a test model for continued testing of technology and equipment • Test the limits of the latest technologies, as vendors continue to offer products with higher capacity and improved efficiencies

Emerging Technologies and Interoperability

As newer, more efficient wireless technologies come to market, opportunities arise to incorporate such technologies into interoperability solutions for public safety. Mr. Eldon Haakinson, Project Manager of the Institute for Telecommunications Sciences in Boulder, Colorado, described two emerging technologies—software defined radios (SDR) and voice-over-Internet Protocol (VoIP)—that hold significant potential as effective interoperability solutions. Table 3 describes the distinct interoperability advantages that each technology offers.

Table 3
SDR and VoIP Interoperability Advantages

Software Defined Radio	
<i>Advantages for Interoperability</i>	<ul style="list-style-type: none"> • Easy and immediate changes to a radio's fundamental characteristics to provide interoperable communications, including— <ul style="list-style-type: none"> – Operating frequencies, bandwidths, and modulations types – Multiple access schemes and source and channel coding/decoding – Frequency spreading and despreading – Encryption and decryption • Many preprogrammed radios can be replaced with one SDR for interoperability
<i>Other Advantages</i>	<ul style="list-style-type: none"> • Different ways to provide programmability (e.g., over-the-air, Internet download, personal computer-to-radio download) • New services, applications, or standards can be rapidly implemented • Increased flexibility and control • Less expensive equipment (since equipment market will be shared with commercial and consumer communities)
Voice-over-IP	
<i>Advantages for Interoperability</i>	<ul style="list-style-type: none"> • Interconnecting systems using the universal, proven IP standard • Network(s) administration conducted from a centralized location • Public safety agencies at all levels of government can access securely and reliably via virtual private network (VPN) connections
<i>Other Advantages</i>	<ul style="list-style-type: none"> • Scalable growth compared with the public switched telephone network (PSTN) • Fewer points of failure compared with the PSTN

As evolving technologies, both SDR and VoIP continue to be tested and evaluated in the field. Mr. Haakinson estimated that SDR handheld units for public safety would arrive to market in roughly five years. However, he pointed out, VoIP was now being implemented to support wide area, end-to-end public safety wireless communications and interoperability in the Commonwealth of Pennsylvania.

Key Issues for Improving Interoperability

Across the Nation, efforts to improve interoperability are thwarted by a myriad of challenges. Two of the more prevalent challenges include an absence of effective interagency coordination and a lack of funding. Participants discussed each of these issues in great detail, and their discussion yielded several best practices, keys to success, and effective approaches for public safety agencies.

Coordination and Partnerships

Improving interoperability largely resides in agencies' ability to work together in the planning and design of interoperability solutions. The Utah Communications Agency Network (UCAN) serves as a model for developing and maintaining effective multiagency partnerships to improve interoperability. UCAN managed the implementation, and currently manages the

operation of this shared regional radio system that supported public safety communications during the 2002 Winter Olympic Games. Mr. Steven Proctor, Executive Director of UCAN and PSWN Executive Committee member, and Mr. Gary Whatcott, Chair of the UCAN Executive Committee, described the formation of UCAN and its keys to success. Table 4 describes three straightforward keys to success in building the UCAN partnership.

Table 4
UCAN Coordination and Partnerships—Keys to Success

Key to Success	Examples from Utah
<i>Support from elected and appointed state officials</i>	<ul style="list-style-type: none"> • 1994: Utah Radio Committee report describing requirements for new statewide public safety radio system is scaled back to a nine-county region encompassing Salt Lake City • 1995: Salt Lake City awarded 2002 Winter Olympic Games; request for proposals (RFP) for regional system released • 1997: UCAN approved by the state legislature as a state government agency directed by a Board of Directors • State legislators continue to advise UCAN and direct actions of the UCAN Board
<i>Management structure</i>	<ul style="list-style-type: none"> • Executive Director manages all UCAN activities and reports to the UCAN Board • UCAN Board consists of 5 state government representatives and 10 local government representatives • Board representatives are elected with term limits
<i>Cross-government participation</i>	<ul style="list-style-type: none"> • Ninety-three local, state, and federal agencies use the UCAN system in some capacity • UCAN Board includes members representing state ITS, three county sheriff departments, and two local fire departments • Sixteen local E911 communications centers are linked to the UCAN system and provide interconnectivity to local public safety agencies

During the 2002 Winter Olympic Games, the UCAN system experienced roughly 145,000 calls over 200 different frequencies per day. It supported 16,500 users during the Games with public safety personnel receiving priority access. As reflected in user comments, the system provided optimal interoperability among public safety personnel during the Games. The UCAN system continues to provide daily and emergency public safety interoperability capacity for the Salt Lake City region.

Funding

Public safety agencies at all levels of government are continually strapped with limited budgets for communications improvement and replacement. As such, funding efforts to improve public safety interoperability remains a significant challenge nationwide. Three speakers representing federal and state government agencies discussed this challenge: Mr. Michael Dame of the Office of Community Oriented Policing Services of DOJ, Mr. Rodney Murphy of the Governor’s Office of Technology of the Commonwealth of Kentucky, and Mr. Tom Wiesner of the Wireless Program Office of the Department of the Treasury. In their discussions, three approaches to technology funding continually surfaced as effective for improving interoperability. Each approach is described in Table 5.

**Table 5
Funding Approaches for Improving Interoperability**

Employ an enterprise approach to funding	
<i>Justification</i>	<ul style="list-style-type: none"> State chief information officers (CIO) are now approaching major information technology investments with an emphasis on enterprise solutions as investments that benefit multiple agencies, promote resource sharing, and avoid redundancy Federal agency CIOs, who are primarily responsible for managing federal LMR assets, are also prioritizing an enterprise approach
<i>Examples</i>	<ul style="list-style-type: none"> The Departments of Justice and the Treasury are now focusing on the implementation of a shared nationwide LMR system that will provide interoperability between enforcement agencies within each department DOJ and Treasury officials have also developed consolidated procurement contracts for Project 25-compliant LMR equipment
Leverage public safety interoperability as an emerging priority political issue to gain buy-in from high-level decision makers	
<i>Justification</i>	<ul style="list-style-type: none"> Public safety communications and interoperability are now important issues that are being considered by legislators at all levels of government as part of homeland security measures The public, as constituents, has yet to fully understand the importance of public safety communications infrastructure as a life-saving public asset
<i>Examples</i>	<ul style="list-style-type: none"> Interoperability is now incorporated as a requirement for local public safety agencies applying for major federal grants used for replacing public safety equipment and information technology
Incorporate recurring costs into all requests for wireless communications funding support	
<i>Justification</i>	<ul style="list-style-type: none"> Public safety wireless communications infrastructure and equipment often ages toward technical obsolescence as a result of limited funding for maintenance and technology refresh Public safety agencies have historically overlooked recurring costs and other critical preplanning measures when drafting RFPs for systems implementation The failure to adjust fee-for-service rates on large LMR networks (e.g., statewide networks) has also contributed to communications budget shortfalls
<i>Examples</i>	<ul style="list-style-type: none"> Treasury is now looking to modify its one year contracts with telecommunications service providers to include longer periods of service to cover recurring costs and ensure sustained, reliable communications

The need to raise awareness among key decision makers about the importance of public safety interoperability was also identified as an important strategy for funding. Ms. Aldona Valicenti, CIO of the Commonwealth of Kentucky, commented that with only four exceptions, states across the Nation were facing budget deficits, and proponents of interoperability must be “vocal and visible” to raise awareness among government leaders to a level that impacts their tough budget decisions today.

Participants also discussed some prospective strategies for funding public safety communications systems. A representative from the National Governors Association asked how funding agreements or mechanisms could be best developed by local agencies to support regional wireless public safety communications systems. In response, Mr. Curt Munro recommended instituting a tax, such as the 911 tax included on local telephone service bills that would devote revenues to maintaining and replacing local public safety LMR infrastructure. He

pointed out that while major federal public safety grants provided sufficient funds for one-time upgrades, such grants did not suffice for full system replacement. Mr. Munro concluded that a more steady, recurring source of funding was necessary for local public safety agencies to increase and maintain their communications and interoperability capabilities effectively.

Current and Emerging Wireless Technologies for Interoperability^{3/4}An Industry Perspective

Today’s wireless technology industry offers the public safety community several options for enhancing their existing communications and interoperability capacities. Emerging wireless technologies also hold promise as effective interoperability solutions in the future.

Representatives from 10 wireless technology vendors and carriers described the capabilities of current and future wireless technologies. Each discussion focused on how such technologies could benefit current or future public safety communications capacity and interoperability. Table 6 describes each vendor offering (listed in alphabetical order).

**Table 6
Vendor Offerings for Public Safety Interoperability**

Arch Wireless		<i>Stewart Leckie, Advanced Applications</i>
<i>Product(s)</i>	<ul style="list-style-type: none"> • Arch Wireless Enterprise Solutions 	
<i>Description</i>	<ul style="list-style-type: none"> • Wireless data network based on XML architecture • Wireless e-mail services and encrypted wireless data transmission based on RSA RC-4 encryption standard 	
<i>Benefit for Public Safety and Interoperability</i>	<ul style="list-style-type: none"> • Allows users to send messages securely and in real time between handheld devices or from devices to any terminal, such as a laptop or stationary computer • Provides Internet connectivity • Eliminates system operations and maintenance responsibilities and costs 	
AT&T Wireless		<i>John Lucidi, National Account Manager</i>
<i>Product(s)</i>	<ul style="list-style-type: none"> • AT&T nationwide cellular voice and data network service 	
<i>Description</i>	<ul style="list-style-type: none"> • Nationwide cellular coverage and PSTN connectivity • Time Division Multiple Access (voice) and Cellular Digital Packet Data (data) integrated network • National “2.5G” network upgrade to global standard for mobile communications for voice and global packet radio switched is sixty percent complete • Plans for implementation on 3G wireless network in late 2002 	
<i>Benefit for Public Safety and Interoperability</i>	<ul style="list-style-type: none"> • Provides several public safety agencies with internal database query and National Crime and Information Center database lookup capabilities • Will significantly increase data transfer rates for subscribers through migration to 2.5G and 3G wireless networks • Will offer new applications, such as video surveillance, mass messaging, or additional database inquiries, on higher capacity networks to supplement public safety communications capacity 	

Daniels Electronics Ltd.		<i>Douglass Bigrigg, Marketing Manager</i>
<i>Product(s)</i>	<ul style="list-style-type: none"> • P25-compliant base stations and repeaters 	
<i>Description</i>	<ul style="list-style-type: none"> • Products use the P25 Phase I standard suite that includes the common air interface signaling format, IMBE vocoder, FDMA channel access, and C4FM modulation, 	
<i>Benefit for Public Safety and Interoperability</i>	<ul style="list-style-type: none"> • Incorporates P25 Phase I standards developed with the intention of improving public safety interoperability by enabling unit-to-unit and unit-to-infrastructure interoperability regardless of vendor technologies • Provides backwards compatibility (i.e., interoperable with legacy conventional analog systems) 	
DynCorp		<i>Justin Murphy, Senior Consultant</i>
<i>Product(s)</i>	<ul style="list-style-type: none"> • Software Adaptive Advanced Computing (SAAC) 	
<i>Description</i>	<ul style="list-style-type: none"> • An apparatus with multiple system configurations: collocated with base stations, mounted in mobile command posts, or deployed as a site on wheels (SOW) • Interoperability between any radio, regardless of frequency bands, modulation schemes, and vendor protocols, and SAAC-appended system • Anticipated production to begin in late 2002, with first implementation to support military programs such as for the Space and Naval Warfare Systems Command 	
<i>Benefit for Public Safety and Interoperability</i>	<ul style="list-style-type: none"> • Allows voice interoperability without replacing existing equipment; capable of quickly determining a user's radio configuration and enabling interoperable communications between user and radio system infrastructure • Provides a stationary interoperability solution for outside users operating within coverage areas of SAAC-appended system • Provides a mobile interoperability solution as an enhancement to mobile command posts or as SOW • P25 compliant 	
JPS Communications		<i>Roger Williams, Vice President</i>
<i>Product(s)</i>	<ul style="list-style-type: none"> • ACU 1000 Modular Interconnect Switch 	
<i>Description</i>	<ul style="list-style-type: none"> • Voice interconnect linking a maximum of twelve individual LMR systems • A maximum of seven simultaneous connections between interconnected systems • Configuration with base station, mobile command post, or transportable units (TFP 1000) 	
<i>Benefit for Public Safety and Interoperability</i>	<ul style="list-style-type: none"> • Provides voice interoperability between disparate systems for users operating within their home network coverage areas • Provides a mobile and transportable interoperability solution • With addition of network extension units (NXU), multiple ACU 1000s can be interconnected via an NXU to provide wide area interoperability 	

M/A-COM		<i>Jay Herther, Director, Product Integration</i>
<i>Product(s)</i>	<ul style="list-style-type: none"> • NetworkFirst 	
<i>Description</i>	<ul style="list-style-type: none"> • NetworkFirst components: SkyGate and SkyCenter <ul style="list-style-type: none"> – SkyGate converts audio from interconnected radio systems to IP packets and sends to central SkyCenter hub – SkyCenter hub serves as an IP voice switch and switches calls among SkyGates 	
<i>Benefit for Public Safety and Interoperability</i>	<ul style="list-style-type: none"> • Provides a wide area interoperability solution linking existing disparate public safety LMR networks and connecting users operating within their home network coverage areas • Offers universal connectivity through PSTN • As IP-based system, allows substantial scalability capable of incorporating continuing advancements in IP and commercial off-the-shelf products 	
Motorola, Inc.		<i>Al Lorenz, Business Manager for Lifecycle Management Services</i>
<i>Product(s)</i>	<ul style="list-style-type: none"> • Radio system life-cycle management services 	
<i>Description</i>	<ul style="list-style-type: none"> • Implementation, technical, and management consulting services 	
<i>Benefit for Public Safety and Interoperability</i>	<ul style="list-style-type: none"> • Manages risks of increasing costs of ownership through effective life-cycle planning for systems development • Integrates interoperability needs, appropriate financial models, replacement costs, and other key management needs into system life-cycle plans 	
Nextel Communications, Inc.		<i>Greg Meacham, Vice President, Federal Programs and Homeland Security</i>
<i>Product(s)</i>	<ul style="list-style-type: none"> • Nextel nationwide cellular voice and data network service 	
<i>Description</i>	<ul style="list-style-type: none"> • Nationwide cellular coverage and PSTN connectivity • Two-way radio and talk group capabilities, as well as wireless data services 	
<i>Benefit for Public Safety and Interoperability</i>	<ul style="list-style-type: none"> • Provides two-way radio interconnect between members of a talk group in any area of the country • Supplements existing wireless voice and data capabilities of “private” public safety LMR networks and can help reduce the number of required channels, capital costs, and maintenance costs • Grants priority access within Nextel system 	
Sprint PCS		<i>Damian Whitham, National Account Manager</i>
<i>Product(s)</i>	<ul style="list-style-type: none"> • Sprint PCS nationwide cellular voice and data network service 	
<i>Description</i>	<ul style="list-style-type: none"> • Nationwide cellular coverage and PSTN connectivity • Code division multiple access (CDMA) network operating in the 1.9 GHz band • Migrating systems to higher capacity, IP packet-switched 3G technologies; 3G system completion expected in early 2004 	
<i>Benefit for Public Safety and Interoperability</i>	<ul style="list-style-type: none"> • CDMA spread spectrum technology provides a level of security • Includes wireless disaster recovery capabilities that offer broadcast text messaging and redundant SONET ring backbone for high-speed data transmissions • Provides 3G services that offer supplementary, high-capacity voice and data for public safety applications such as high-speed wireless data connectivity to VPNs or the Internet, push-to-talk, and text messaging 	

TX/RX Systems, Inc.		<i>Sean Johnson, Director</i>
<i>Product(s)</i>	<ul style="list-style-type: none"> • Very high frequency, ultra high frequency, and 800 MHz signal boosters 	
<i>Description</i>	<ul style="list-style-type: none"> • Radio signal amplification to expand system coverage areas • Enhanced output capability for existing infrastructure 	
<i>Benefit for Public Safety and Interoperability</i>	<ul style="list-style-type: none"> • Increases system coverage in areas that usually have unreliable coverage, such as tunnels, mountainous valleys, and within buildings 	

Looking Ahead...

Although much remains to be addressed for public safety interoperability, the Current and Emerging Solutions to Public Safety Communications Interoperability Summit started an important dialog between government and industry leaders. Public safety interoperability is inherently a challenge best addressed through partnerships—between government agencies, between agencies and vendors, and between public and industry leaders.

The partnership between government and industry leaders remains critical, particularly as advancements in other areas evolve positively for public safety interoperability. The application of industry standards, such as P25, is helping to improve interoperability technically and increase competition to lower equipment costs for public safety agencies. Politically, interoperability is emerging as a high-profile issue as part of homeland security and antiterrorism initiatives. Looking ahead, continuing the dialog between government and industry leaders remains pivotal to effectively steering such advancements in the right direction and establishing public safety interoperability as an accepted standard for public safety communications nationwide.