The National Institute of Justice's CommTech Program has a mission to assist State and local law enforcement agencies to effectively and efficiently communicate with one another across agency and jurisdictional boundaries. It is dedicated to studying interoperability options and making valuable information available to law enforcement, firefighters, and emergency technicians in different jurisdictions in communities across the country.
Topics

- Radio communications interoperability and public safety
- Challenges to achieving communications interoperability today (fragmented frequency bands, incompatible equipment)
- Current communication interoperability technologies/products available to public safety
- NIJ CommTech/NLECTC Assistance
What is Interoperability

The ability of public safety agencies to talk to one another via radio communications systems – to exchange voice and/or data with one another on demand, in real time, when needed.

Why is Interoperability Necessary

Day to day incidents such as car chases, motor vehicle accidents and major incidents such as the events on September 11, demonstrate that there is a need for seamless communications among the first responder team: police, fire, medical services and transportation.
Current First Responder Community

- 2,500,000 Public Safety First Responders in the U.S. Today
  - 28,713 Fire and 6,034 EMS Departments (1)
    » 960,000 firefighters
    » 830,000 emergency personnel
  - 15,221 Law Enforcement Agencies (2)
    » 710,000 Law Enforcement Officers
Why Public Safety Can’t Communicate Between Agencies and Departments

Five Key Reasons
• Incompatible and aging communications equipment
• Limited and fragmented funding
• Limited and fragmented planning
• Lack of coordination and cooperation
• Fragmented radio Spectrum
Interoperability Challenges

- **Technical:**
  - Radio Communications:
    - Radio Frequency Assignments span the radio spectrum.
    - No single commercial grade radio spans all PS frequencies.
    - Incompatible protocols coexist within the same band.
  
  - Information Technology:
    - Information exchange among public safety agencies is limited due to incompatible database formats and legal concerns.

- **Economic:**
  - Fully interoperable infrastructure is likely to be cost prohibitive and is not practical in the short term (sunk investment).

- **Organizational:**
  - Management philosophy/practices that impede shared systems.
Communication Interoperability Solutions

- Single System (Local, State & Federal)
- Multiple Subscriber Units (cache of radios)
- Shared Channels
- Interconnects (patches, cross connects etc.)
- Standards-Based Systems

There is No “Silver Bullet” Solution
Communication Interoperability
Solutions Continued

Single System (Local, State & Federal)

advantage - provides the highest level of communication interoperability between all users

disadvantage - capital cost, estimated at 18.3B to replace entire infrastructure (17.1B for State and Local), requires extensive planning, coordination and participation by all agencies
Communication Interoperability Solutions Continued

Multiple Subscriber Units

• On-scene Distribution (radio swap/caches)
  
  advantage - allows immediate interoperability
  
  disadvantages - capital cost, loss, distribution, training, maintenance funding justification

• Permanent Installation
  
  advantage - mitigates incompatible radio system problem, no additional infrastructure cost
  
  disadvantage - requires multiple radios, limited to existing coverage area of host agency
Communication Interoperability Solutions Continued

Shared Channels

• Mutual Aid
  - advantage - minimizes confusion by using a dedicated channel
  - disadvantages - band specific, requires multi-jurisdictional participation

• Established Channel-Sharing Agreements
  - advantage - provides immediate interoperability
  - disadvantage - band specific, limited to participating agencies, requires detailed planning, limited to existing coverage area of host agency
Communication Interoperability Solutions Continued

Interconnects

• Patching
  
  advantage - solution is relatively easy to implement
  
  disadvantages - delay in establishing connection during emergencies, not deployable, requires, not spectrally efficient, limited coverage, may create channel loading problems

• Crossband Repeaters
  
  advantage - allows users to use own equipment
  
  disadvantage - to implement across several bands requires multiple crossband repeaters, limited to coverage area of repeater, may create channel loading problems
Communication Interoperability Solutions Continued

Interconnects

• Audio Switches (system-to-system interconnects)
  
  advantage - provides interoperability between almost any combination of radios

  disadvantages - can be costly on large scale implementation, not spectrally efficient, limited coverage, may create channel loading problems

• Networked Trunked LMR Systems
  
  advantage - provides wide area communication

  disadvantage - costly requires complex networks and end-user equipment upgrades or purchase, interoperability only achieved between users
Communication Interoperability Solutions Continued

Standards Based System

• Project 25 (P25)
  advantage - eliminates proprietary radio issues
  disadvantages - band specific, limited number of manufactures, cost can be significant, additional components of standard remain to be adopted

• Voice Over Internet Protocol (VoIP)
  advantage - provides faster more efficient and more secure data communication, scalability, range extension
  disadvantage - no standard (not plug and play), equipment is very limited
Equipment Available Today
TR30-1102 Tactical Interoperability Kit

Features and Function

- Low cost tactical cross-connect system.
- Links up to 3 radio groups of any combination VHF, UHF and 800 MHz.
- Capable of range extension when used in repeat mode.
- Supports cross-banding of P-25 radios with existing conventional or trunked radios.

Transcrypt International
TCB-I Tactical Communication Bridge

Features and Function

• Interoperability solution for mixed protocol radios.
• Rapid field deployment during emergency operations.
• Homeland Security and Search & Rescue applications.
• Radio cross-band controller with two separate radio ports.
• Built-in repeater controller with simplex/duplex modes.
• Includes 2 radio ports, RS-232, and 7 output control lines.
• 2 Minutes of digital voice storage per radio port for simplex repeater operation.
• Easy interfacing utilizing the built-in radio database.

Link Communications, Inc.
TCB-II Tactical Communication Bridge

Features and Function

- LCD touch-screen allows field configuration, port monitoring and radio adjustment control.
- Adjustable VOX - non-VOX based COR inputs.
- Supports analog, digital and cellular radios.
- DTMF control allows remote operating mode.
- Support for cellular and PTT mobile phones.
- Adaptive audio delay prevents missing the beginning of transmissions.
- Digital voice storage for simplex repeater operation.
- Easy interfacing utilizing the built-in radio database.

Link Communications, Inc.
Features and Function

- TCB-2 RSP includes 6 Tait VHF/UHF radios
- Housed in a rugged industrial shock mounted field case with casters.
- User configurable radio features utilizing the TCB-2 (No computer needed to adjust the radio’s frequency).
- Adjustable transmitter output power can be adjusted from 1 watt up to 25 watts (helps minimize on-site receiver desense between closely spaced operating frequencies).
- 4, 6 and 8 radio version available.

Link Communications Inc.
ICRI/WF™ Incident Commanders' Radio Interface™

Features and Function

• ICRI/WF is a portable, easy to set-up "SWITCH" joining different radios in a common voice net across bands and incompatible platforms.
• Interconnects multiple military and/or public safety radios in any combination (800/400/ 150MHz, low band VHF, AM/FM, digital/analog, trunked/talk-around) and Nextel telephone.
• Lightweight (weighs 2 ½ pounds).
• Designed for fire-line or base operations (heavy gauge chassis/field serviceable).

Communications-Applied Technology
ICRI™ Incident Commanders' Radio Interface™

Generation III with expanded capabilities

Features and Function

- ICRI is a portable, easy to set-up "SWITCH" joining different radios and telephones in a common voice net across bands and incompatible platforms.
- Interconnects multiple military and/or public safety radios in any combination (800/400/ 150MHz, low band VHF, AM/FM, digital/analog, trunked/talk-around) and cellular telephone.
- Provides reliable radio link between emergency response team operating in areas of poor RF propagation (e.g.: in buildings and subways) or remotely located C2 personnel.

Communications-Applied Technology
ICRI™ Incident Commanders' Radio Interface™ Generation III Rack Mount

Features and Function

- Tactical radio interoperability for emergency response personnel.
- Interconnects municipal public safety radios, state and federal radios and telephone in just a couple of minutes.
- ICRI provides a rugged, highly-portable, radio cross-band (VHF, UHF, 800MHz), cross platform (digital/analog, trunked/talk-around, AM/FM) capability for mutual aid operations.
Aegis SafetyNet™ RadioBridge™

Features and Function

• 16-Channel, 5 Group model for large metropolitan areas.
• Interfaces almost any combination of radios and cell phones.
• Built-in 48-hour battery (can also use D-cells).
• 8-Channel model available to meet smaller requirements.

Aegis Assessments, Inc.
Infinimux G4 Portable

Features and Function

- Infinimux G4 is a modular interconnect system that is suitable for HF, LMR, SATCOM, cellular, Nextel, VoiP and PSTN systems.
- Interfaces almost any combination of radios and telephones in multiple simultaneous two-way or conference calls.
- Optional modules include quad radio, quad PSTN, quad PA, dual PSTN and mixed I/O.
- Software controlled through PC or front panel soft-switch system.

Infinimode Systems Inc.
**Infinimux G4 Portable**

**Features and Function**

- Infinimux G4 is a modular interconnect system that is suitable for HF, LMR, SATCOM, cellular, Nextel, VoiP and PSTN systems.
- Interfaces almost any combination of radios and telephones in multiple simultaneous two-way or conference calls.
- Optional modules include quad radio, quad PSTN, quad PA, dual PSTN and mixed I/O.
- Software controlled through PC or front panel soft-switch system.

Infinimode Systems Inc.
Infinimux G4 Rack Mount

Features and Function

- Infinimux G4 is a modular interconnect system that is suitable for HF, LMR, SATCOM, cellular, Nextel, VoiP and PSTN systems.
- Interfaces almost any combination of radios and telephones in multiple simultaneous two-way or conference calls.
- Optional modules include quad radio, quad PSTN, quad PA, dual PSTN and mixed I/O.
- Software controlled through PC or front panel.
- Sophisticated DSP algorithms provide adaptive hybrid, voice modulation recognition, VOX, and Noise reduction.

Infinimode Systems Inc.
INTEROP-9 Multi-Band Interoperability Radio System

Features and Function

• In-band and link repeater for VHF & UHF and 800 MHz radios with provisions for remote repeat/link enable/disable via DTMF code.
• Equipment is mounted in four weatherproof cases
• Provides for over-the-air low-voltage and charge indications.
• Kit includes radio service laptop computer with range analysis, antenna isolation calculation software and mapping software.
• Kit includes portable (magnetic mounted) antennas.
ACU-T Intelligent Interconnect System

Features and Function

• ACU-T is a modular interconnect system that is suitable for HF, LMR and SATCOM systems.
• Interfaces almost any combination of radios and telephones in multiple simultaneous two-way or conference calls.
• Optional modules interface HF radios and local telephone sets.
• Software controlled through attached laptop, which can be remote controlled with an addition of a serial/Ethernet interface.

JPS Communications, Inc. (Raytheon)
**TRP-1000 Transportable Radio Interconnect**

**Features and Function**

- TRP is built around the ACU-1000 which is a modular interconnect system that is suitable for HF, LMR and SATCOM systems.
- Interfaces almost any combination of radios and telephones in multiple simultaneous two-way or conference calls.
- Optional modules for HF radios/local telephone sets.
- Software controlled through attached laptop, which can be remote controlled over a LAN/WAN.
- Sophisticated DSP algorithms provide adaptive hybrid, voice modulation recognition, VOX, and Noise reduction.

JPS Communications, Inc. (Raytheon)
ACU-1000 Intelligent Interconnect System

Features and Function

• ACU-100 is a modular interconnect system that is suitable for HF, LMR and SATCOM systems.
• Interfaces almost any combination of radios and telephones in multiple simultaneous two-way or conference calls.
• Optional modules for HF radios and local telephone.
• Software controlled through attached laptop, which can be remote controlled over LAN/WAN.
• Sophisticated DSP algorithms provide adaptive hybrid, voice modulation recognition, VOX, and Noise reduction.

JPS Communications, Inc. (Raytheon)
SR-3001 Radio Interoperability System

Features and Function

• SR-3001 is a software-based interoperability system with unlimited scalability.
• System provides seamless communications between disparate radios and GSM, Nextel/Verizon (P2T), POT lines, Iridium, Globalstar, IMARSAT satellite phones, Saber/Astro Motorola, VHF & UHF radios, marine radios etc.
• Audio buffering “delay” between trunked and conventional radio systems.
• All communications are automatically recorded and both audio and data can be archived to DVD.
• Radio and telephone analysis software available.
IDS-1600 Intelligent Digital Switch

Features and Function

• Radio Interface: Suitable for HF, Low Band, VHF, UHF, 800Mhz, 900Mhz, LMR radios and SATCOM & telephone.
• Auto Ports: 16 ports expandable to 32 ports.
• Data Ports: Up to 16 RS232 COM ports.
• Up to 16 Multiple Simultaneous Two-way or Conference Calls.
• External DTMF control.
• Software provides system setup and control.
• Rugged, transportable systems are available.
• 19" rack mount package.

VDV Media Corporation
Vega Viper-8

Features and Function
- 4 Telex IP-223 Radio Controllers
- External connection for up to 8 different portable radios
- External Cat-5 network connection
- Internal network router
- 110 – 240V @ 100watts max power supply
- Rugged weather resistant mil-spec case

Telex Communications
Vega MCU

Features and Function

- Panasonic Toughbook™, with a Pentium® M 725, 1.6GHz processor
- Telex C-Soft 12-line Dispatch Console
- Telex Network Recorder
- 4 Telex IP-223 Radio Controllers
- Hotspot wireless connection between dispatch console and the network
- Built-in storage drawers for laptop computer and accessories
- External speakers
- External connection for up to 8 different portable radios
- External Cat-5 network connection with internal network router
- Rugged weather resistant case

Telex Communications
Network First Interoperability Gateway

Features and Function

• NFI Gateway is a software-based multi-channel codec module designed to interface IP digital networks with analog equipment.
• Interfaces almost any combination of radios nets, phone lines and dispatch console equipment in multiple simultaneous two-way or conference calls.
• Network users are automatically connected to legacy system users by selecting designated voice groups.
• Digitized voice coding using advanced multi-band excitation is used and then encapsulated into IP packets and sent along an IP digital network.
• Rack mounted card cage that accepts up to twelve interoperability cards with VME back-plane that offers rear mounting expansion slots.

M/A-COM
Motobridge Soft Switched Radio Network

Features and Function

- Enables first responders from different jurisdictions operating on different radio systems to quickly achieve interoperability.
- Uses standard Internet Protocol (IP) signaling.
- Seamlessly connects users from systems on different frequencies or platforms.
- Works with existing consoles to add basic joint dispatch capabilities to include ability to record and replay last 60 seconds of audio.
- Virtual radio head remotely controls Motorola radios (change channels etc.)

Motorola
Catalyst Communications Technologies

IP Link

Features and Function

• IP Link is an add-on software package to Catalyst product. Can be used to route audio from radio-to-radio between different types of systems that these products support.

• Each agency is a peer. There is no central switch eliminating the need to request a patch from a third party.

• Each gateway can be individually set to allow patches or not allow patches. Thus the supervisor for each agency makes the final decision if his agency will participate.

• Radio gateway stores packets from the last call until the attached radio is ready to transmit.
IP Radio, Fleet, Base, Tone, or Network Access Radio

- IP Link, is an add-on software module that works in conjunction with the server application.
- Radio signals are received by the fixed radio are demodulated, decrypted, and converted to baseband audio by the fixed radio.
- The gateway converts the audio to compressed, digital packets and routes it to the appropriate IP addresses across the network. IP addresses can be other gateways or remote PCs used as dispatch positions.
- Any PC on the network can become a dispatch console. In most cases the gateway provides either an advanced functionality or tone control of radio.

Windows® screens provide an enhanced visual method for viewing information about your radio.

Catalyst Communications Technologies

The Global View Window shows the PC user the status of all the Radio Gateways on the network.

The Call History Window shows the PC user the last 32 calls at each location. A record of every call, and its recording if enabled, is stored at the Gateway.
WAVE Dispatch Communicator™

- Software console for dispatch and command and control operations.
- Lets designated operators patch together users, groups and agencies, select and unselect audio, monitor conversations, and view user status and presence.
- Communicator runs on a standard Windows PC or laptop, supports touch-screens, and can be used in dispatch centers, tactical units, and remote locations.

WAVE Desktop Communicator™

- PC interface for interoperable group communications.
- PC integration with any two-way radio, hoot network, landline phone, mobile phone, or connected PDA.
- Users can join multiple talk groups, view user status and presence information, send instant messages, and generate specialized radio tones.
- Communicator runs in a web browser or as a standard Windows application, works over a LAN, and extends your communications to remote and mobile users with VPN access.

Twisted Pair Solutions
Voice Over IP (VoIP) & Radio Interoperability

- Interoperability Between Disparate Radio Models and Frequencies
- Converged Communication Across Radios, Phones, Computers & Wireless PDA’s
- Voice Over IP Architecture Extends Range of Radios to Secure Internet
- Enables Inter-Agency Text & Voice Communication
Cisco IP Interoperability and Collaboration System “IPICS”

Voice Over IP (VoIP) & Radio Interoperability

- Server/router based interoperability solution
- Interoperability Between Disparate Radio Models and Frequencies
- Converged Communication Across Radios, Phones, Computers & Wireless PDA's
- Voice Over IP Architecture Extends Range of Radios to Secure Internet
- Enables Inter-Agency Text & Voice Communication
The goal of CommTech’s technology assistance program is to provide assistance to public safety agencies in applying interoperability solutions once an agency has determined the solution that will provide the level of communications interoperability required.
Interop Tech Assist Activities

- Bossier Parish Interop Assistance Project Shreveport, LA
- DOJ High Risk Metro Area Interop Assistance Project NYC, NY
- DOJ Project Seahawk Interop Assistance Project Charleston, SC
- U.S. Border Patrol Interop Assistance Project Houlton, ME
- US State Department Interop Assistance Portsmouth, NH
- North Central Wisconsin Regional Planning Committee Interop Assistance Project Wausau, WI
- Presidential Inauguration Interop Assistance, DC
- RapidCom 10 City Interop Assistance Project San Francisco, CA
- DOJ High Risk Metro Area Interop Assistance Project Detroit, MI
- Alamo Area Council of Governments Interop Assistance Project San Antonio, TX
- Middle Rio Grande Development Council Interop Assistance Project (Eagle Pass) Uvalde, TX
- Val Verde County Sheriff’s Office Del Rio, TX
- RapidCom 10 City Interop Assistance Project Boston, MA
- Denton County Sheriff’s Department Interop Assistance Project Denton, TX
- Franklin County Sheriff’s Department Ottawa, KS
- DOJ High Risk Metro Area Interop Assistance Project St. Louis, MO
- DOJ High Risk Metro Area Interop Assistance Project Boston, MA
- DOJ High Risk Metro Area Interop Assistance Project Norfolk, VA
- DOJ High Risk Metro Area Interop Assistance Project Miami, FL
- Hurricane Rita Disaster Recovery Interop Assistance, Texas
• Created in 1994 as a component of the National Institute of Justice's (NIJs) Office of Science and Technology, the National Law Enforcement and Corrections Technology Center (NLECTC) system serves as the "honest broker" offering support, research findings, and technological expertise to help State and local law enforcement and corrections personnel perform their duties more safely and efficiently.

• The NLECTC system consists of facilities across the country that are co-located with an organization or agency that specializes in one or more specific areas of research and development. Although each NLECTC facility has a different technology focus, they work together to form a seamless web of support, providing technology assistance, support, and information.
Available Resources

"Why Can’t We Talk" Video

CommTech Brochure

Technology Short’s

"Why Can't We Talk“ A Guide for Public Officials & Video

CommTech Resource CD-ROM
NLECTC Resources On-Line "Virtual Library"

- Biological, Chemical, & Radiological Defense
- Explosives Detection & Remediation
- Biometric Identification
- Commercialization
- Communications Interoperability
- Concealed Weapon Detection
- Contraband Detection

- Crime Mapping
- Electronic Crime
- Corrections
- Federal Property
- Firearms
- General Publications
NLECTC Resources On-Line "Virtual Library"

- Information Sharing and Analysis
- Investigative and Forensic Sciences
- Less-than-Lethal Incapacitation
- Offender Monitoring / Officer Location
- Transportation Infrastructure Security
- Perimeter Security
- Personal Protection
- Pursuit Management

- Restraint Systems
- School Safety
- Speech Enhancement
- Standards and Testing
- Surveillance
- Vehicles
QUESTIONS?
For Additional Information

• Check our websites

• Contact NLECTC-SE
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