



Technical Solutions

Trunked/Conventional Interconnect

Trunked/Conventional Interconnect Solution...Introduction...

THIS TRUNKED/CONVENTIONAL INTERCONNECT SOLUTION ANALYSIS HIGHLIGHTS THE FOLLOWING

- Technical description and conceptual drawings
- Appropriate uses
- Advantages and disadvantages
- Costs
- Spectrum requirements
- Management issues
- Security and standards issues
- Implementations

THREE POSSIBLE INTEROPERABILITY OPTIONS CAN BE IMPLEMENTED TO ESTABLISH COMMUNICATIONS BETWEEN AGENCIES USING AN 800 MEGAHERTZ (MHz) TRUNKED SYSTEM AND AGENCIES USING A VERY HIGH FREQUENCY (VHF) CONVENTIONAL (NON-TRUNKED) SYSTEM

- Permanent Patch Option
- Console–Console Patch Option
- VHF Trunked Intelli-Repeater (I/R) Option

THE PERMANENT PATCH OPTION DIRECTLY CONNECTS A DESIGNATED INTEROPERABILITY CONVENTIONAL CHANNEL INTO A TRUNKED SYSTEM

- Permanent patch involves a direct connection of a specific mutual aid or dedicated conventional channel to the trunked dispatch center
- This option can be implemented by—
 - Connecting a conventional base station to the trunked system console through a base station-to-console interface card via a 3002 analog voice circuit or equivalent
 - Connecting a trunked base station or a trunked desktop unit to the conventional system console
- The field units can make inquiries to the trunked (or conventional) system directly. Upon the reception of an inquiry, the dispatcher sets up talk group assignment, and then notifies the calling party about the established connection

INTEROPERABILITY BETWEEN CONVENTIONAL AND TRUNKED SYSTEMS CAN BE ACHIEVED BY ESTABLISHING AN AUDIO CONNECTION BETWEEN THE DISPATCH CONSOLES OF THE SYSTEMS

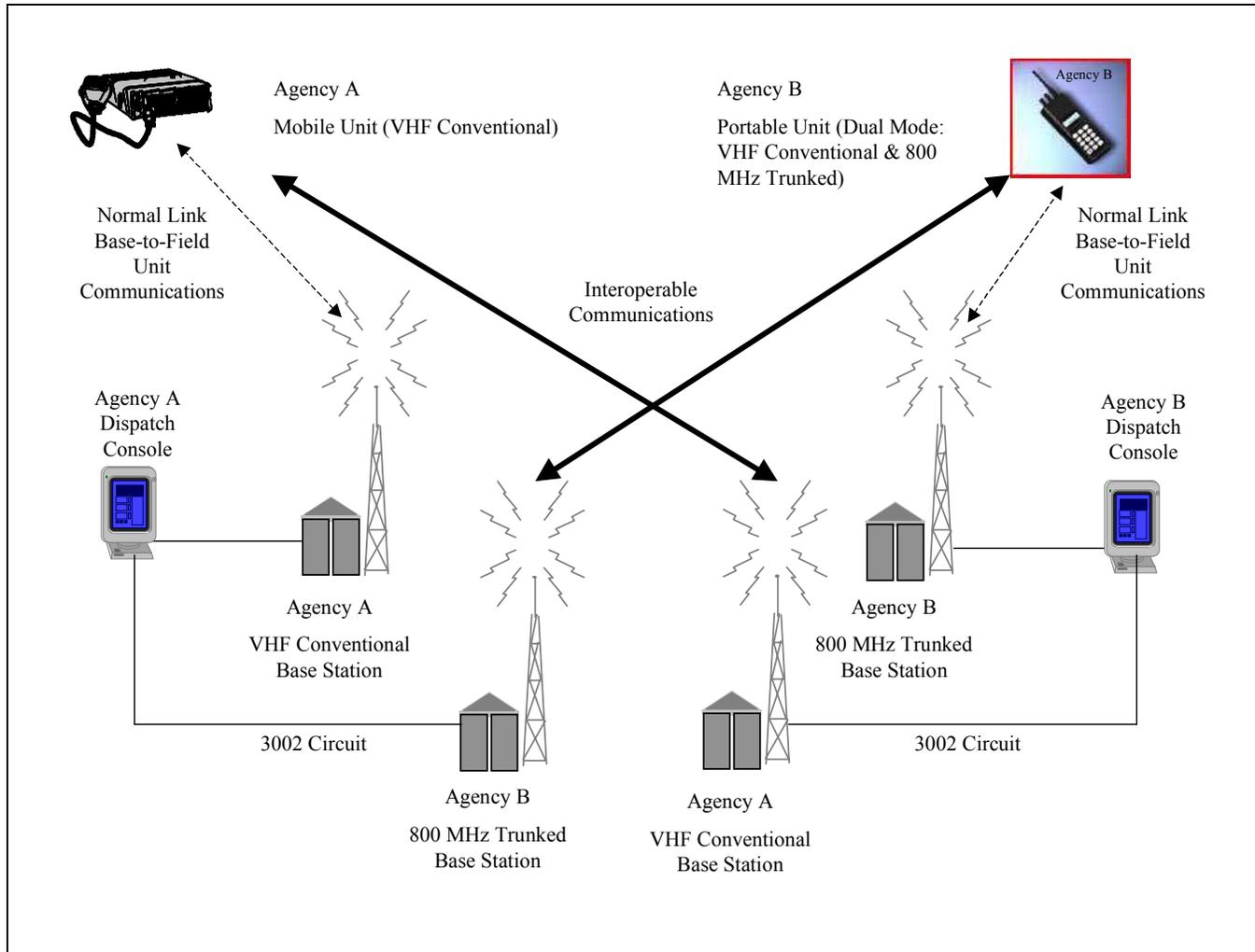
- Public safety agencies typically use a central dispatch console for an audio interconnect
- The typical console audio interface is 600 ohm balanced audio
- Console–console patches can be implemented in any way that accommodates available audio interfaces
- Three ways are typically used—(see Console–Console Patch Solution for more details)
 - The public switched telephone network (PSTN) (dial-up console access)
 - A dedicated leased line (3002 or equivalent)
 - A dedicated microwave or fiber link (voice channel assignment in multiplex)
- The field units can make inquiries to their local dispatchers. Upon the reception of an inquiry, the dispatcher connects a console-to-console call to the second dispatcher, negotiates call routing setup and talk group assignment, and then notifies the calling party about the established connection

VHF TRUNKED INTELLI-REPEATER IS A VIABLE OPTION TO ACHIEVE INTEROPERABILITY AMONG CONVENTIONAL SYSTEMS AND MOTOROLA TRUNKED SYSTEMS

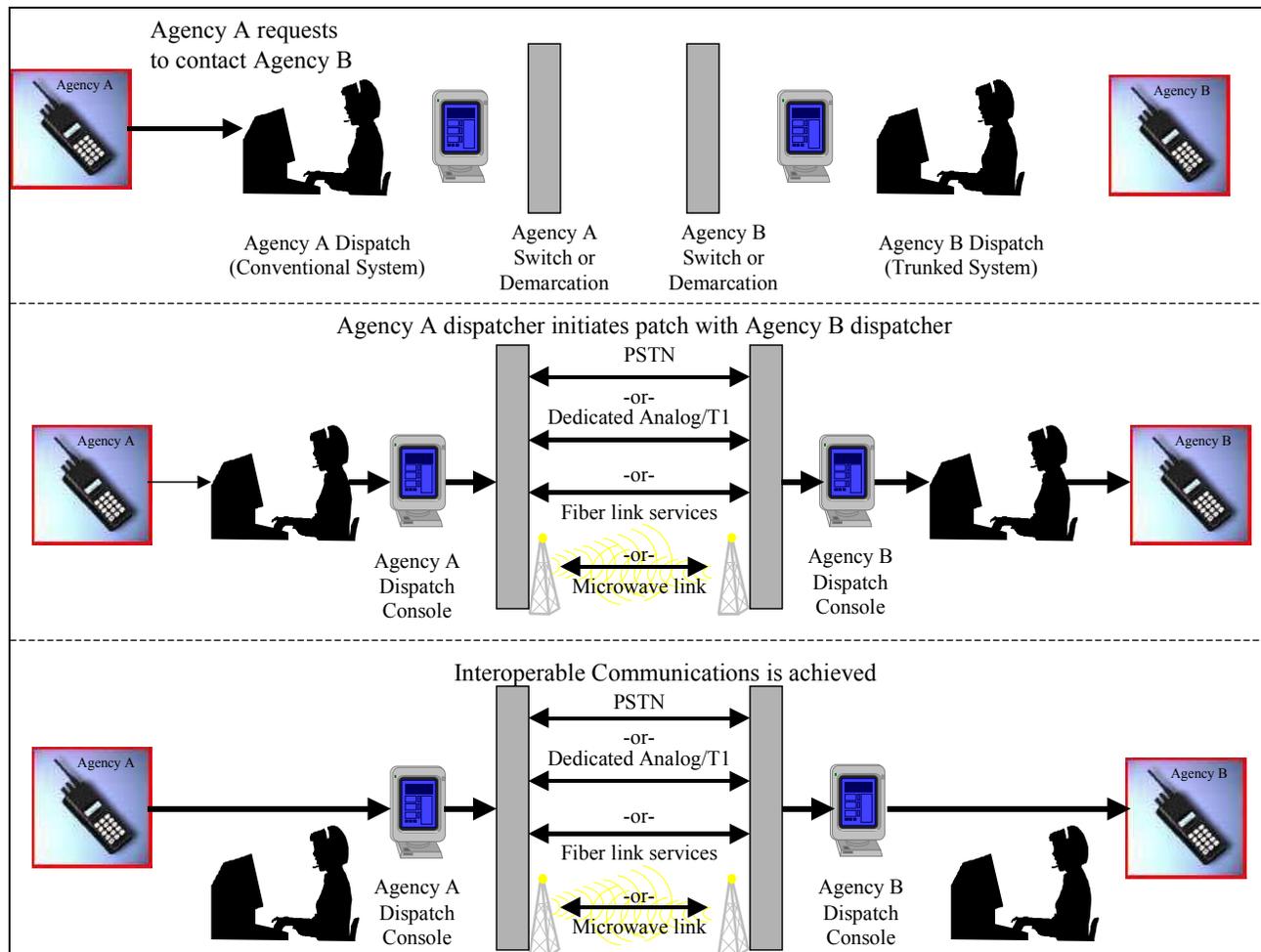
- This option enables a VHF conventional channel to coexist and co-operate on the same trunked channel controller
- The VHF trunked I/R option can be regarded as a special case of the base station-to-base station crossband repeater solution in which a VHF trunked repeater is directly tied to a neighboring trunked SmartZone system controller (see the Cross-System Interconnect Solution for more details concerning the SmartZone system)
 - A trunked VHF repeater must be installed as an addition to the conventional VHF infrastructure, directly connected to a neighboring trunked system controller and dedicated to handle control signaling
 - The number of additional trunked repeaters needed depends on the required number of simultaneous interoperable talk groups (i.e., one repeater per talk group)
 - This option is only a viable solution for Motorola trunked systems
 - See the Crossband Repeater Solution for more details addressing analog and digital methods of connecting the trunked VHF repeater to the neighboring SmartZone system controller
- Field units with an interoperability mission must be multimode radios or conventional radios that must be FLASHport upgraded to accommodate the SmartZone trunked mode and any other conventional operation mode that may be required
- The field units can request an interoperability talk group directly through the trunked system controller. According to the talk group setup, appropriate conventional and trunked channels are dedicated through their designated repeater stations, and the connection gets established

Trunked/Conventional Interconnect Solution...Conceptual Drawings...Permanent Patch Option...

THE DRAWING BELOW ILLUSTRATES THE CONCEPT OF TRUNKED/CONVENTIONAL INTERCONNECT USING PERMANENT PATCH

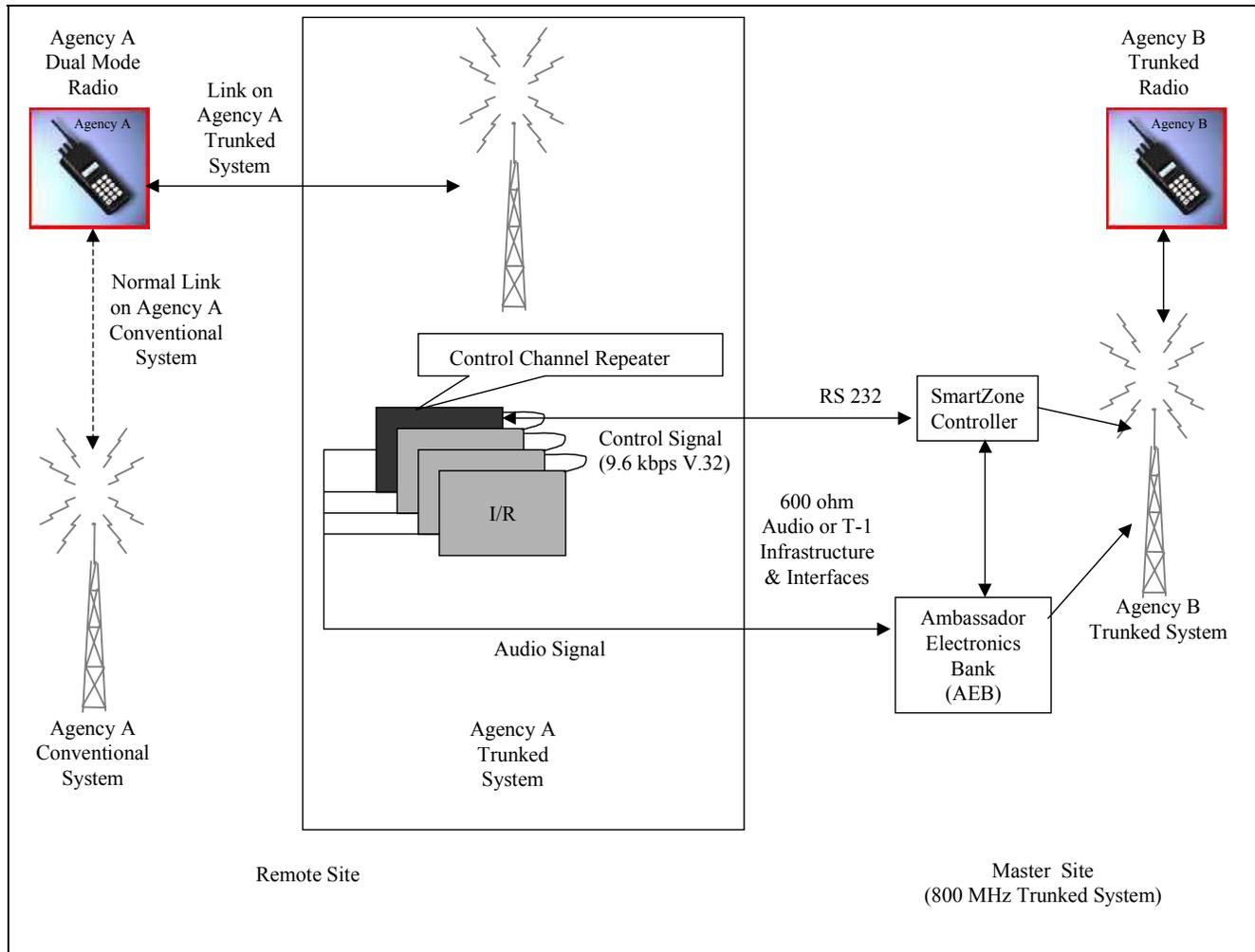


THE DRAWING BELOW ILLUSTRATES THE CONCEPT OF TRUNKED/CONVENTIONAL INTERCONNECT USING CONSOLE-CONSOLE PATCH



Trunked/Conventional Interconnect Solution...Conceptual Drawings...VHF Trunked I/R Option...

THE DRAWING BELOW ILLUSTRATES THE CONCEPT OF CONTROL AND AUDIO CONNECTIONS FOR VHF TRUNKED I/R



Trunked/Conventional Interconnect Solution...Appropriate Uses...

LINKING SYSTEMS THROUGH A TRUNKED/CONVENTIONAL INTERCONNECT IS A VIABLE SOLUTION FOR PUBLIC SAFETY INTEROPERABILITY IN THE FOLLOWING SITUATIONS

- The permanent patch and console–console patch options are viable solutions when one of the public safety agencies needing to achieve interoperability uses a conventional system and the other uses a trunked system
- The VHF trunked I/R option is a viable solution when public safety agencies operating conventional systems need to achieve interoperability with a neighboring Motorola trunked system
- The VHF trunked I/R option will help the conventional system agency transition to a trunked system

Trunked/Conventional Interconnect Solution...Advantages...

EACH TRUNKED/CONVENTIONAL INTERCONNECT OPTION HAS SEVERAL ADVANTAGES

Advantage	Permanent Patch	Console– Console Patch	VHF Trunked I/R
Provides rapid communications access for field units using channel or mode selectors	✓		✓
Requires coverage overlap between the conventional and trunked systems	✓	✓	✓
Provides coverage for specific areas or over a wide area such as a multicounty region or a state	✓	✓	✓
Provides resources that can be controlled by dispatchers	✓	✓	
Ease of implementation	Fairly Easy	Simplest	Difficult
No specific system required; participation open to any agency with a dispatch console	✓	✓	
No subscriber equipment requirements; no need to buy, trade, or reprogram radios	✓	✓	
No subscriber feature requirements—basic features adequate; no need to switch frequency bands or operating modes	✓	✓	
Fairly minimal costs	✓	✓	
Patch delays minimized because dispatcher intervention minimized (no need for dispatchers to relay messages)		✓ ¹	✓

¹ In the case of microwave or fiber link connect

Trunked/Conventional Interconnect Solution...Disadvantages...

EACH TRUNKED/CONVENTIONAL INTERCONNECT OPTION ALSO HAS SEVERAL DISADVANTAGES

Disadvantage	Permanent Patch	Console-Console Patch	VHF Trunked I/R
Participating jurisdictions must coordinate multijurisdictional implementation	✓	✓	✓
Frequencies may need special coordination for mutual aid use and cannot be used for operations	✓		
Users must be trained to initiate patch with dispatcher and accommodate patch delays	✓	✓	
Dispatchers must be trained to use equipment; i.e., recognize dispatching cues from field agents and initiate a patch with participating agencies	✓	✓	
Additional equipment may be required at console	✓	✓	✓
Patch must be removed when interoperability not required		✓	
Patch latency increases transmission time per message, possibly limiting radio system capacity temporarily during patch	✓	✓	
High cost of implementation and infrastructure investment		✓ ¹	✓
Necessitates an unencrypted link between radios, a security weakness	✓	✓ ²	✓
May require reprogramming each subscriber unit involved to include the interoperability channel. Potentially time consuming (depending on number of units) and costly (if reprogramming is performed by a vendor)	✓	✓	✓

¹ In the case of microwave or fiber link connect

² In the case of PSTN connect

COSTS VARY, DEPENDING ON THE OPTION

- Permanent Patch Option—
 - Fairly low cost for the implementation of the base station-to-console interface connection
 - Field unit costs include reprogramming
- Console–Console Patch Option—
 - Cost varies depending on how the console–to–console patch is implemented. PSTN and dedicated leased line costs are fairly minimal. Initial costs for dedicated microwave or fiber link may be high (see Console–Console Patch Solution Costs section)
 - Field unit costs include reprogramming
- VHF Trunked I/R Option—
 - I/R implementation cost is significant because I/R equipment costs are high compared to the previous options and an extra repeater is required for the control channel
 - Field unit costs include reprogramming or purchasing of multimode field units

SPECTRUM REQUIREMENTS VARY, DEPENDING ON THE OPTION

- The Permanent Patch Option requires additional spectrum to be coordinated and licensed specifically for the dedicated conventional channel unless previously licensed spectrum is used
- The Console–Console Patch Option generally requires no additional spectrum because patches typically use previously licensed spectrum
- The VHF Trunked I/R Option—
 - Requires additional spectrum for the dedicated (control signaling) repeater
 - Generally uses previously licensed spectrum for the additional talk group repeaters

COORDINATION AND MANAGEMENT REQUIREMENTS VARY, DEPENDING ON THE OPTION

- The Permanent Patch Option requires significant management by the public safety agencies involved
 - Clearly defined guidelines must be developed to —
 - Define appropriate use of the resource
 - Establish control of the resource
 - Govern real-time control of the resource by console operators and field users
 - Identify funding and resources for implementation and maintenance
 - Capital funding for the infrastructure components
 - Funding or responsibility for equipment maintenance
 - Funding for any ongoing rental costs of communications lines, towers, and equipment space
 - Involved agencies may need to take special steps to coordinate frequencies for mutual aid or dedicated channels

COORDINATION AND MANAGEMENT REQUIREMENTS VARY, DEPENDING ON THE OPTION (CONTINUED)

- The Console–Console Patch Option requires significant management by the public safety agencies involved
 - Console–console patches require training, staffing, and communications system monitoring
 - Users and dispatchers must be trained
 - Dispatchers must be available at each end of the connection to establish and terminate connection
 - PSTN patches also require dispatcher involvement during the communications
 - Radio managers must monitor message transmission time and radio system capacity to ensure acceptability
 - Formal interoperability procedures should be developed to ensure that users follow established procedures
 - Console–console patches also require significant coordination
 - Interconnection capabilities of each agency’s central dispatch console must be identified
 - Requirement for a temporary or permanent connection must be determined
- The VHF Trunked I/R Option requires significant management by the public safety agencies involved
 - The VHF Trunked I/R solution requires training and possibly significant system development
 - Users must be trained
 - Dispatchers must also be trained if each radio has several interoperable channels
 - The pause for access to any trunked systems may increase the need for user training
 - The VHF Trunked I/R solution also requires significant coordination
 - Participating agencies must decide which agency has primary control of interoperability radio equipment
 - Formal interoperability procedures should be developed to ensure that users follow established system procedures

THESE OPTIONS CAN AFFECT COMMUNICATIONS SYSTEM SECURITY

- Permanent Patch Option—
 - Security may be addressed through the use of—
 - Encryption in the field units
 - Transparent base stations and repeaters
 - Encryption/decryption equipment at the consoles
 - However, encryption algorithms must be compatible, and interoperability key(s) must be managed
- Console–Console Patch Option—
 - Using a PSTN patch can raise security issues
 - Using a dedicated leased line or dedicated microwave or fiber link avoids the PSTN, thereby increasing security
 - Console–console patches do not raise standards issues; they circumvent incompatibility in systems and subscriber equipment
- VHF Trunked I/R Option—
 - Participating agencies must accept another agency's having primary control of an infrastructure device in their communications systems
 - Repeater solutions do not raise standards issues; their objective is to circumvent system incompatibility

SEVERAL TRUNKED/CONVENTIONAL INTERCONNECT SOLUTIONS HAVE BEEN IMPLEMENTED IN LOCAL, STATE, AND FEDERAL PUBLIC SAFETY ENVIRONMENTS

- The City of El Paso uses a semipermanent patch to link operational districts together for long- and short-term operational needs. For example, the northeast and west police talk groups were patched together for several months so that they could be dispatched simultaneously from one dispatch position. A short-term example is patching together selected police talk groups to coordinate movement of sensitive government equipment along a selected route through El Paso. This might only take a few hours
- Many public safety agencies across the United States achieve interoperability by using console–console patches. For example—The Immigration and Naturalization Service (INS) and the Florida Department of Law Enforcement in Miami have a full-time console–console link via a leased telephone company circuit. This link is used primarily to provide interoperability between INS agents and the Florida Highway Patrol officers. This interoperability has been expanded to include links from the INS to the Federal Bureau of Investigation (FBI), Metro–Dade County Police Department, Monroe County, Broward County, and the U.S. Coast Guard
- Federal and local public safety agencies in eastern Virginia use a shared conventional/trunked system interconnected using the I/R option. The shared trunked system is an 800 MHz SmartZone system. Multiple other agencies operating on the 450 MHz band can share the common 800 MHz system