



Technical Solutions

Multiband, Multimode Radios

THIS ANALYSIS OF MULTIBAND, MULTIMODE RADIOS HIGHLIGHTS THE FOLLOWING

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

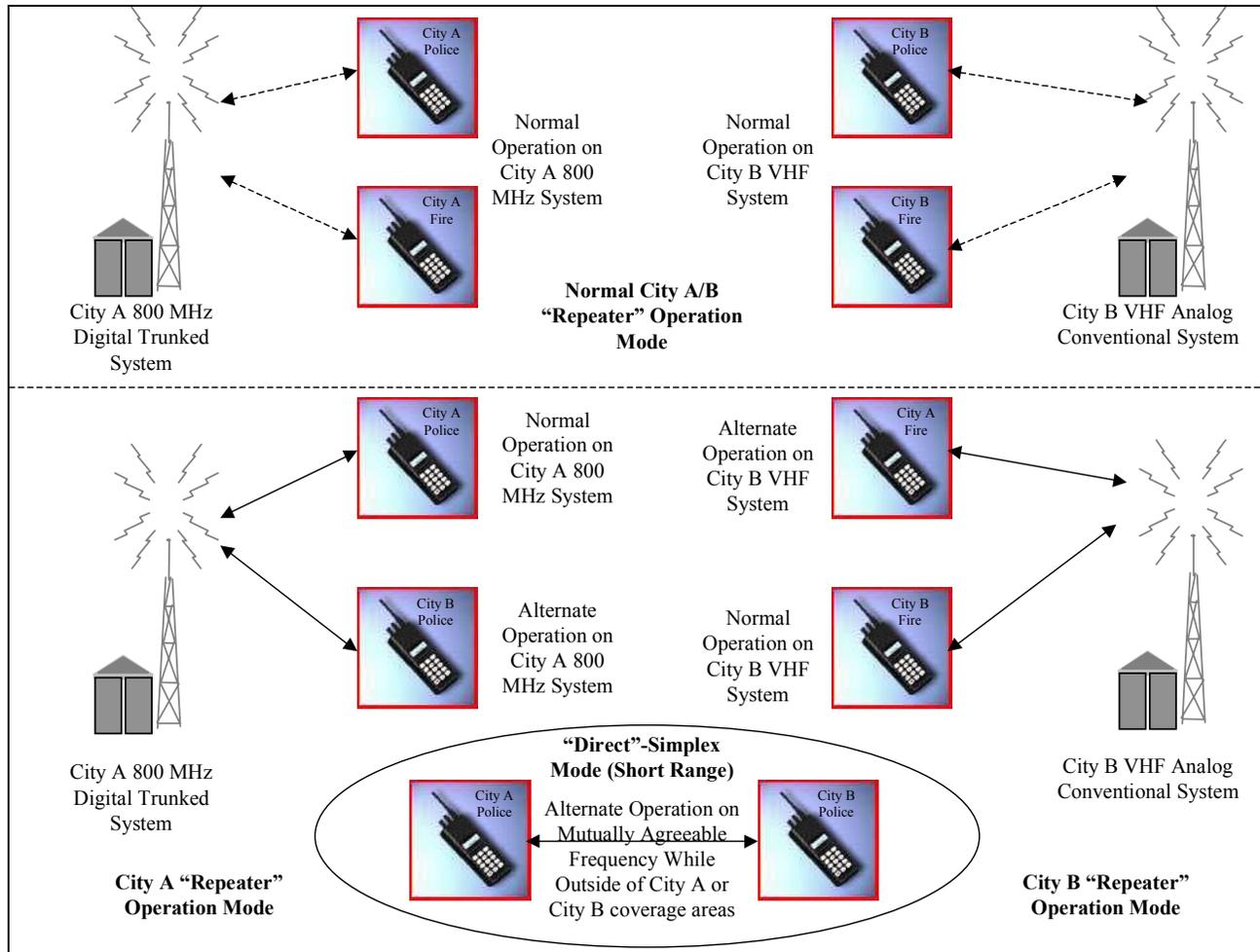
MULTIBAND, MULTIMODE RADIOS PROMISE TO ACHIEVE INTEROPERABILITY AMONG SUBSCRIBER UNITS ON THE SAME SYSTEM OR ON DIFFERENT SYSTEMS

- Subscriber units from the same agency or from different agencies can interoperate with each other if they can operate on multiple frequency bands in multiple operating modes. This technology is currently being developed, but a few vendors now provide this capability in their subscriber units. For example, the Multiband Inter/Intra Team Radio (MBITR) manufactured by Racal provides contiguous coverage from 30 megahertz (MHz) to 512 MHz and operates in amplitude modulation (AM) and frequency modulation (FM) voice and data modes
 - If users are on the same system, they will merely select a common channel or talk group and a common mode of operation (clear, encrypted, FM, digital, etc.). In effect, they share a common technology, the ideal interoperability scenario
 - If the users are on different systems, multiband, multimode radios will be able to provide excellent flexibility
 - If systems use different frequencies, all users desiring interoperability will switch to a common frequency band and operate in the same mode to achieve unit-to-unit communications. This capability will be especially helpful when some of the interoperating subscriber units are outside their “home” system coverage area
 - If all users desiring interoperability are outside the coverage area of any compatible backbone system, they will select a preprogrammed simplex frequency and a mode to allow short-range, unit-to-unit communications for field operations
 - If systems use different frequencies and operate in different modes, users who are outside their home system coverage area will switch to the frequency band and operational mode necessary for interoperability with the desired units in the desired system

MULTIBAND, MULTIMODE RADIOS PROMISE TO ACHIEVE INTEROPERABILITY AMONG SUBSCRIBER UNITS ON THE SAME SYSTEM OR ON DIFFERENT SYSTEMS (CONTINUED)

- Example: A Florida Highway Patrol (FHP) officer in Miami needs to interoperate with an Immigration and Naturalization Service (INS) agent in the same city
 - The FHP subscriber unit operates on a Motorola 800 MHz digital trunked radio system. The INS unit operates on a Motorola very high frequency (VHF) analog conventional radio system
 - If the interoperability need occurs in an area covered only by the FHP system, the INS user would first have to switch frequency bands from VHF to 800 MHz. Next, the INS agent would have to switch modes from conventional analog to digital trunking in the Motorola format. Then, interoperability between the two units would occur via a designated talk group on the FHP system
 - If the interoperability need occurs in an area covered only by the INS system, the FHP user would first have to switch frequency bands from 800 MHz to VHF. Next, the FHP officer would have to switch modes from digital trunking to conventional analog. Then, interoperability between the two units would occur over a designated channel on the INS system
 - In the rare event that both users needing interoperability were outside the coverage area of both systems, they could switch to a mutually agreeable frequency band and operational mode and talk directly unit to unit without benefit of a fixed backbone radio system. This capability would have very limited range and no direct radio contact with any system dispatcher

THE DRAWING BELOW ILLUSTRATES THE CONCEPT OF MULTIBAND, MULTIMODE SUBSCRIBER UNITS



Multiband, Multimode Radio Solution...Appropriate Uses...

MULTIBAND, MULTIMODE RADIOS ARE A VIABLE SOLUTION WHEN THE PUBLIC SAFETY AGENCIES THAT NEED TO INTEROPERATE USE—

- Two proprietary trunked systems from different manufacturers
- Two proprietary trunked systems from the same manufacturer, and the newer system is not backward compatible with the older system
- Either the same frequency band or different frequency bands
- Different operational modes
- Any combination of these factors

THE MULTIBAND, MULTIMODE RADIO SOLUTION HAS SEVERAL ADVANTAGES

- No dispatcher intervention is required to set up and remove the interoperability link
- Agencies can establish more than one simultaneous interoperability talk group or channel simply by having the subscriber units switch to the proper frequency band or operational mode or both
- Agencies need not change, reprogram, or add to the radio system infrastructure on any of the backbone radio systems involved in the interoperability scenario
- Outside agencies can join the interoperability talk group(s) or channel(s) by simply selecting the right switch positions on their subscriber units
- Because interoperability is achieved without any changes or additions to the fixed radio system infrastructure, no additional wireline leased circuits are needed, thus avoiding potential leased circuit failure, audio path distortion, or transmission of external energy (such as lightning) into communications shelters

THE MULTIBAND, MULTIMODE RADIO SOLUTION ALSO HAS SEVERAL DISADVANTAGES

- In emergencies, subscriber units that are outside their home coverage area are also out of touch with their dispatch center. Users have to ask the dispatcher on the system providing interoperability to relay messages via telephone, for example, to their home system dispatcher
- Radios with full multiband, multimode capabilities are still under development and are available only from a few vendors on a limited basis
- True multiband, multimode subscriber units must be programmed for the different systems they may need to access. These arrangements will require significant planning and management to ensure that the radios are properly programmed to meet likely interoperability needs
- Programming subscriber units for access to trunked radio systems will require significant cooperation among all users. Trunked radio system programming devices require a system code key that is unique to each system. Subscriber units that “roam” among several systems would have to be programmed with each system key to have access to all systems
- The various agencies that would share infrastructures to support multiband, multimode subscriber unit interoperability would have to generate and prosecute a number of interlocal agreements or memorandums of understanding (MOU) to ensure that the interoperability solution is used in the way that is most beneficial to all agencies involved. Creating and carrying out these agreements is sometimes a lengthy, costly process requiring significant legal input

THE MULTIBAND, MULTIMODE RADIO SOLUTION IS COST EFFECTIVE

- The multiband, multimode interoperability solution requires significant initial investment, including—
 - Acquiring multiband, multimode subscriber units
 - Programming the units to operate on all desired radio systems
 - Creating all required interlocal agreements or MOUs
- After the initial investment, the ongoing or recurring costs are relatively modest
 - The subscriber units must be maintained. Because of their complexity, their maintenance cost will probably exceed that of other radios
 - As new interoperability needs are identified, the subscriber units will have to be reprogrammed to include any new radio systems that would provide the radio coverage in the needed areas. The programming effort may require outside vendor support
 - As new systems are identified to provide interoperability, the interlocal agreements or MOUs will have to be updated, or new ones created
 - Personnel costs are minimized because this type of interoperability does not require dispatcher setup

Multiband, Multimode Radio Solution...Spectrum Requirements...

THE MULTIBAND, MULTIMODE RADIO SOLUTION REQUIRES NO ADDITIONAL SPECTRUM

This solution typically uses previously licensed spectrum

THE MULTIBAND, MULTIMODE RADIO SOLUTION REQUIRES MINIMAL TO MODERATE MANAGEMENT BY THE PUBLIC SAFETY AGENCIES INVOLVED

- The system manager of each system on which the multiband, multimode subscriber units will operate must identify and manage those units. Modern trunked radio systems support this management process by automatically logging unit identification numbers and times of activity
- Dispatchers are not required to initiate the interoperability link
- Training is required for users to learn new multiband, multimode features because the subscriber units are more complex than standard radios. Users do not need to learn to accommodate interoperability link delay, however, because it will be no greater than normal subscriber unit traffic delay on the system being used
- Although this interoperability solution is simple to implement, formal interoperability procedures should be developed to ensure that users follow established procedures on each other's systems
- Detailed MOUs or interlocal agreements are critical to making sure that all agencies understand their roles in the partnership
- The flexibility of programming different frequencies may lead to unauthorized use of certain frequencies

THE MULTIBAND, MULTIMODE RADIO SOLUTION CAN ACCOMMODATE COMMUNICATIONS SYSTEM SECURITY

- The multiband, multimode subscriber unit is expected to have a multimode encryption feature. It should be able to accept encryption code keys from numerous different systems and key loaders. It should also be able to provide end-to-end encryption because no console linking or patching will be required for the interoperability solution to function. The clear audio that normally passes between the consoles in a console-console patch is not a problem in this interoperability solution
- This solution does not raise standards issues; its objective is to circumvent system incompatibility

Multiband, Multimode Radio Solution...Implementation...

THE PUBLIC SAFETY WIRELESS NETWORK (PSWN) PROGRAM IS NOT CURRENTLY CONDUCTING A PILOT PROJECT FOR MULTIBAND, MULTIMODE SUBSCRIBER UNITS, NOR IS ANOTHER IMPLEMENTATION KNOWN