Developing Multi-Agency Interoperability Communications Systems: User's Handbook

Applicable To: ACU-1000 Modular Interface/Interconnect System And TRP-1000 Transportable Radio Interconnect System

Developing Multi-Agency Interoperability Communication Systems: User's Handbook

ACU-1000 Modular Interface/Interconnect System
And
TRP-1000 Transportable Radio Interconnect System

Presented by:
Office for Domestic Preparedness

This project was supported by Contract GS-10F-0088I/2001BF505TO02, Task Order 2001TO046, awarded by the U.S. Department of Justice, Office of Justice Programs to Community Research Associates, Inc. The Assistant Attorney General, Office of Justice Programs, establishes the policies and priorities, and manages and coordinates the activities of the Office of Justice Programs, Bureau of Justice Statistics, National Institute of Justice, Office of Juvenile Justice and Delinquency Prevention, and the Office for Victims of Crime. Points of view in this document are those of the author and do not necessarily represent the official position of the U.S. Department of Justice and Community Research Associates, Inc.

Foreword

The Office of the Assistant Attorney General, Office of Justice Programs (OJP) is providing funds through the Office for Domestic Preparedness (ODP) State Domestic Preparedness Equipment Program for the purchase of specialized equipment to help enhance the capabilities of State and local units of government to respond to acts of terrorism involving chemical and biological agents, as well as radiological, nuclear, and explosive devices.

This handbook is the result of a developed and focused effort by the ODP to address interoperability and is intended to enhance communications among the numerous agencies who would respond to large-scale terrorism incidents or emergencies.

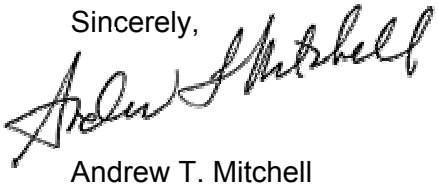
To further enhance that effort, the ODP provided more than 50 ACU/TRP-1000 systems to approximately 10 jurisdictions across the United States under a pilot grant project. The communities cited in the handbook were selected from among those provided with the ACU/TRP-1000 systems that were part of the ODP pilot grant project.

The ACU/TRP-1000 system is a useful communications device for those who must establish a link with other local, State, and federal agencies at the scene of multi-agency response incident. This system provides radio interoperability during incidents or events requiring communications between diverse organizations all using different radios and/or different frequencies.

I look forward to building upon the strong relationships that already been developed with you and your colleagues during the first year of this very important program.

Through our combined efforts, State and local emergency response agencies will receive the funding and assistance they need to enhance their capabilities and prepare for an event that will hopefully never take place.

Sincerely,



Andrew T. Mitchell

Acting Director

Office for Domestic Preparedness

Table of Contents

List of Figures

1 INTRODUCTION TO ACU-1000/TRP-1000 HANDBOOK

1.1 Preface

This handbook is intended to provide pragmatic information and practical steps on set-up and operation of a multi-agency interoperability communications system using the highly adaptable ACU-1000 Modular Interface/ Interconnect System (ACU-1000), and the TRP-1000 Transportable Radio Interconnect System (TRP-1000).

Section Two, Introduction to Multiple Agency Interoperability, provides background on multiple agency interoperability communication along with basic information on the ACU/TRP-1000 Gateway Switch/ Interoperability Communications System, including a general overview of its operation.

Section Three, Establishing an Interoperability System, outlines the basic set-up and initial operating procedures of the ACU/ TRP-1000 Interoperability Communication System.

Section Four, Technical and Tactical Considerations, presents valuable insight and experience gained through a survey of jurisdictions that have had operational experience with the ACU/TRP-1000 Interoperability Communications Systems.

Section Five, Operating System Models, is provided to further assist users involved in setting up their own multi-agency interoperability communication system. This section presents descriptions of setup and deployment by jurisdictions that are using the ACU/TRP-1000. These system models demonstrate the potential for achieving a high performance system. From these reviews, new users will be better prepared to set-up and operate comprehensive systems that take full advantage of the capabilities of the ACU/TRP-1000.

This handbook is designed to enhance a jurisdiction's ability to use the ACU/TRP-1000 and to manage interoperability issues. The result will be an appreciation of how this system can deliver optimum, high performance results for emergency response agencies.

1.2 Grant Program Support

The National Institute of Justice, a bureau in the Office of Justice Programs, conducted research into use of the JPS Communications, Inc., ACU/TRP-1000 systems in conjunction with the Multiple Agency Radio Interoperability System (MARIS), under the Advanced Generation Interoperability for Law Enforcement, (AGILE) Program. This program conducted a detailed multi-phased survey of all ACU/TRP-1000 systems shipped under the grant program. Information from this program is available online at: www.nij-agile.jhuapl.edu.

1.3 Preferred Technical Capabilities

Individuals assigned to operate the ACU/TRP-1000 should possess, at a minimum, the following requirements:

1. Land mobile radio systems experience. Experience should encompass a good understanding of different frequency bands, different types of modulation (example, AM, FM, HF APCO/digital), trunking systems.
2. An understanding of radio theory such as receiver intermodulation interference a plus.
3. Some basic understanding of antenna theory, wave propagation, feed line, RF connectors (PL-259f N/mini-UHF) is preferred.
4. Basic knowledge of all the radios that may be interfaced with the system.
5. Ability to program a variety of radios during a situation as new groups enter the network by referring to the ACLJ-1 000 manual.
6. Technical degree or certificate preferred but not required, amateur radio experience a plus.

7. PC experience working in a Windows™ 95, 98, 2000, NT, MI environment is a must.
8. Experience in using phone patches and explaining to users on the phone that the radio is not full duplex like the telephone.
9. Ability to run a console type of communications gear and be a system operator is required.

1.4 Acknowledgements

In part, this handbook draws upon information from the AGILE Program that was established in 1998. The AGILE Program, supported by multiple Interagency Agreements including 1999-IJ-CX-AO94 and 1000-LT-VX-A034, was awarded by the U.S. Department of Justice, Office of Justice Programs, and National Institute of Justice.

Under this program, all of the interoperability projects then under way in the U.S. Department of Justice were combined by the National Institute of Justice. The result was establishment of a three-pronged approach that addresses both short-term and interim interoperability solutions as well as long-term interoperability solutions to be implemented through standardization of wireless telecommunications and information technology applications.

Some material presented in this handbook is taken from the National Institute of Justice, AGILE MARIS Program Study. That research studied the feasibility for emergency service agencies to utilize communications technology that was initially developed for the military. That study evaluated the two interoperability electronic systems, the ACU-1000 Modular Inter-connect System, and the TRP-1000 Trans-portable Radio Interconnect System manufactured by JPS Communications, Inc.

Any analysis, evaluation and review offered by this handbook does not represent product approval or endorsement by the Department of Justice; the National Institute of Justice, the Office for Domestic Preparedness, or any other agencies who may be cited within this document. The point of view and opinions contained within this handbook are those of the grant program participants.

2 INTRODUCTION TO MULTI-AGENCY INTEROPERABILITY COMMUNICATION

2.1 Multi-Agency Interoperability Communication

In its simplest terms, multi-agency interoperability communication is the ability of two or more public safety agencies to exchange information, when and where it is needed, even when different communication/information systems are involved. Multi-agency interoperability communication systems encompass the ability to exchange information among fixed facilities, mobile platforms, and portable (personal) devices.

2.1.1 Importance of Multi-Agency Communication

Effective and efficient emergency response requires coordination, communication, and sharing of information among numerous public safety agencies. Thousands of incidents that require mutual aid and coordinated response happen each day.

High profile incidents, such as bombings or plane crashes, test the ability of emergency service organizations to mount well-coordinated responses. In an era where technology can bring news, current events, and entertainment to the farthest reaches of the world, many law enforcement, firefighter, emergency medical service, and other emergency response personnel cannot communicate with each other during routine operations let alone major emergencies.

Voice communication is not the only issue. Advances in technology have placed an increased dependence on the sharing of data, images, and video. As a result, interoperability (the ability of two or more organizations to communicate and share information, be it voice, data, images, or video) has been brought to the forefront as a key issue for our nation's emergency response agencies.

2.1.2 The Interoperability Solution

A fundamental interoperability challenge today is wireless voice communication among agencies that have different radio systems operating on various radio frequencies. It is intended that the AGILE program will ultimately address this issue through adoption of interoperability standards. However, while those standards are being developed, other mechanisms are needed that can address the interoperability requirements. One solution is the Gateway Switch device, also called an audio matrix or cross band switch, that links different radio systems.

Not unlike a dispatcher's patch panel, the Gateway Switch device simply passes base band audio signals from the receiver portion of one radio to the transmitter portion of a dissimilar radio system. For example, audio from the receiver function of a Very High Frequency (VHF) transceiver can be passed to the transmitter circuitry of an Ultra High Frequency (UHF) transceiver. An advantage of the Gateway Switch device over the dispatcher's patch panel is that it requires no manual intervention once configured.

The Gateway Switch device automatically routes voice calls from one radio system to another via control signals input by a radio user. It will also allow a connection between radios and telephone or cellular phones, or vice versa. In addition, the Gateway Switch has a degree of versatility that is not available via the dispatch patch panel.

The Gateway Switch device can be configured either as a fixed base unit or for use in a mobile platform that is transportable in a van, sports utility vehicle or command vehicle. In a transportable mode, the Gateway Switch device becomes a mobile repeater, allowing different radio systems to communicate in a wide geographical radius around an incident.

2.2 ACU-1000 & TRP-1000 Interoperability Communication Systems

This handbook discusses both the fixed base and mobile interoperable communications systems. The ACU-1000 Modular Interconnect System (as shown in **Figure 2-1**) is designed for fixed base operations. This system, manufactured by JPS Communications, Inc., contains the Gateway Switch, and is capable of interconnecting diverse radio, telephone, and cellular units to allow multi-agency communication. This system has the added benefit of adding a backup capability to regular communication and dispatch systems.

Figure 2-1 ACU-1000 Electronic Console – radio systems patch into this panel, which can be connected to a computer.

The TRP-1000 Transportable Radio Interconnect System puts the Gateway Switch in a shock-resistant case for mobile transportation and operation. It incorporates all the same functions as the ACU-1000 system, plus it comes standard with five UHF and five VHF radios for field use.

The greatest asset of both the ACU-1000 and the TRP-1000 systems is their ability to provide communications interoperability between HF, VHF low band, VHF high band, UHF, 800 MHz, 900 MHz, trunking talkgroups, and encrypted networks.

2.3 ACU-1000 Modular Interconnect System

The ACU-1000 units are designed to interconnect dissimilar radio systems by distributing the audio or voice-band signals from selected radios or telephone connections to other specified radios or telephones connected via the Gateway Switch. By connecting directly to each radio's control circuitry, the ACU-1000 can detect when a radio on the switch is receiving audio (to be distributed to other radios) and assert the "push-to-talk" on those radios to which the audio is to be transmitted.

2.3.1 Components of the ACU-1000 Modular Interconnect System

- Interface modules, each designed to connect communication devices such as radios and telephones
- Control module
- Power supply module
- Local operator interface module
- Chassis to accommodate the modules
- Backplane to route audio and control signals between modules
- Computer controlled software

2.4 TRP-1000 Transportable Radio Interconnect System

The TRP-1000 is a package consisting of one or more transportable cases that includes multiple radios pre-wired to a Gateway Switch. The radios, which cover all possible frequency bands or interoperations needed, can be cross-connected through the Gateway Switch.

The TRP-1000 (as shown in **Figure 2-2**) contains multiple radios that can be quickly programmed to the (transmit and receive) frequencies of involved agencies. These radios can then be cross-connected by the built-in Gateway Switch in a variety of ways, including a mixture of 2-way and conference conversations as well as a mix of permanent and temporary connections to include radios, telephones, and cellular phones.

2.4.1 Components of the TRP Transportable Interconnect System

- Self-contained
- Five VHF portable radios
- Five UHF portable radios

- Portable antennas
- Power supplies
- The ACU-1000 cross-band gateway switch
- Rugged polymer transportable case

Figure 2-2 TRP-1000 – Includes the ACU-1000 Electronic Console in Shock resistant casing with pre-connected mobile radios and power supplies.

2.4.2 Potential Applications of the Interoperable Communication Systems

Both the ACU-1000 and the TRP-1000 systems are excellent tools for emergency agencies responding to an incident requiring coordination among multiple agencies. The ACU/TRP-1000 systems provide crossband operation between agencies as diverse as FEMA, Red Cross, the National Guard, local emergency management, law enforcement, fire departments, and emergency medical services, as well as other public service agencies that might be involved.

In instances where it is needed, the ACU/TRP-1000 systems can assist in 911 call center applications. The ACU/TRP-1000 systems can prevent overloading of the local 911 center communications circuits during a large-scale emergency by providing direct radio interoperability for emergency personnel outside the 911 center's normal communications systems. For instance, the ACU/TRP-1000 systems can facilitate interoperable communication at a hazardous materials spill in which HazMat, EMS, fire, and law enforcement personnel operate on alternate cross-connected frequencies. The interoperability system allows the 911 center to return to handling normal emergency call traffic rather than serving as the network communication center for the HazMat incident.

ACU/TRP-1000 systems can be set up within minutes to solve several communication problems such as:

- first response communications interoperability during the initial 24 to 48 hours of an emergency
- supplementing or extending the reach of fixed base radio communications coverage
- transportable communications backup with flexible system configuration
- enhancing local, state and federal interoperability during emergency situations and special events.

3 ESTABLISHING INTEROPERABILITY

The advents of more and more multiple agency emergency response incidents have brought with them the need of multi-agency inter-communication. This dynamic component of multi-agency emergency response has become a major problem.

Now, with assistance of new technology, the capability to have seamless communications across the full radio spectrum is possible. However, many jurisdictions are reluctant to establish new operational approaches and implement new communications methods.

Based on ACU/TRP-1000 System demonstrations, the Office for Domestic Preparedness (ODP) funded a pilot program to place approximately 50 units in around 10 jurisdictions to determine the practicality of communications interoperability and the functionality of the ACU/TRP-1000 System.

Figure 3-1 Laptop and radio frequency monitoring equipment connected to TRP-1000 system.

Every jurisdiction that received the units for testing and deployment had positive evaluations of the equipment. Many of the jurisdictions are well advanced in their plans to deploy the unit, and some have devised creative approaches to using the equipment. A few jurisdictions have passed the formal implementation stage and have developed operating procedures that incorporate use of the system into their emergency response plans.

3.1 Set-Up and Operation

Emergency response agencies provided with the ACU/TRP-1000 System reported minimal problems in setting-up the unit for use. Many agencies indicated they were able to operate the unit within minutes after unpacking the equipment. Other agencies had minor set-up issues that were quickly resolved by contacting JPS Communications for technical assistance.

The first out-of-the-box initial setup, programming, and installation of additional radios may require a communications specialist/technician. However, operation of the unit once assembled is easily handled by dispatchers or other communications staff. Brief training on use of the unit is generally sufficient for operating. Most users find the software easy to understand and intuitive to use.

3.1.1 Cabling

The TRP-1000 comes with 10 multi-channel conventional radios pre-connected to the unit and covers a wide range of frequencies. All of these radios can be programmed to various jurisdictions' frequencies. Additional radios can be added (to cover other frequencies or to expand capability) of the TRP-1000 by connecting them via a cable connection to an open port on the system, or by replacing one of the radios supplied with the unit.

Constructing the proper cabling to connect these additional radios to the TRP-1000 requires the ability to read and interpret electrical schematics. This is a simple but critical task for a radio technician. This task involves creating a connection cable (or rewiring an existing cable) for each radio brand or type so that it can interface with the TRP-1000 generic audio port. One cable is needed for every additional brand or type of radio connected to the TRP-1000.

It is recommended that new users develop a collection of pre-constructed cables to be transported with the TRP-1000 that can interface with radios from neighboring jurisdictions as well as state and federal assets. As with most emergency response issues, pre-planning to handle communications needs will speed the integration of other agencies into the system.

3.1.2 Interconnection Schematics

The manufacturer of the ACU/TRP-1000 system, JPS Communications, notes that many of the schematics supplied by radio manufacturers for pin-out configurations are not correct. This can prevent proper connection of the radio to the TRP-1000 unit.

JPS will provide schematics for any radio if the jurisdiction wishes to make their own cables, or JPS will provide pricing for pre-manufactured cables if the agency wishes to purchase them.

The user should check model numbers carefully as similar looking radios and similar sounding model numbers may have completely different pin-out configurations requiring separate cables. They should contact JPS with any problems in connecting radios to the unit. Several jurisdictions were able to quickly resolve their connection problems with one call to JPS staff, which provided fax versions of correct pin-out configurations.

3.1.3 Security Issues - Encryption

Since the ACU/TRP-1000 systems operate on the principle of taking the analog voice signal from any radio, telephone or other electronic equipment, and re-transmitting this signal over another radio channel, it is possible to connect them to a radio operating on an encrypted system, or to connect encrypted radios from separate systems together.

Because there is the capability of connecting an encrypted radio system to a non-encrypted system, use of JPS equipment with encrypted systems should be carefully engineered to limit the system only to connecting one encrypted system to another. JPS has recommendations for setup and operation of the system using encrypted radios to minimize the potential for inadvertently interconnecting encrypted radios into a non-encrypted system. Users should contact JPS for recommendations if encryption is an issue for their jurisdiction.

3.2 Deployment Options

One of the greatest strengths of the TRP-1000 system is its nearly limitless capability to interconnect virtually any device that produces an audio signal to another device. This provides an overwhelming number of configuration and deployment options that can be daunting when deciding how the unit should best be used in the field. Initially most jurisdictions use the out-of-the-box configuration to see how the system operates and then experiment with various set-up options to determine how the equipment can best enhance their unique requirements.

3.2.1 Frequencies to Install

Once jurisdictions have conducted sufficient testing to assure themselves that the TRP-1000 will actually work well in their system, the question arises regarding what agencies should be programmed into the system for "daily" use - and what radios should be added to the system to obtain the maximum benefit from the unit.

As noted, the basic configuration for the TRP-1000 includes 10 multi-frequency radios that can be programmed to cover several radio bands. Most jurisdictions that have 800 MHz capability have added an 800 MHz radio to the TRP-1000 (or replaced one of the units provided) to obtain interoperability with their existing frequencies.

Other radios can be connected to the TRP-1000 to allow communication with virtually any agency. Jurisdictions should carefully consider all of the agencies that would respond at major incident scenes and pre-plan capabilities to allow interoperability,

such as frequency lists, private line tones, and emergency contact information.

3.2.2 Connecting Portable Radios

While many jurisdictions have purchased mobile radios to add to the ACU/TRP-1000 system, other agencies have chosen the option of connecting a portable radio to the ACU/TRP-1000 to accommodate other jurisdiction's frequencies once on the scene.

While the flexibility of adding the portable radios is a valuable option, if a jurisdiction plans to operate with another agency for any prolonged period, it should consider acquiring mobile radios to accommodate the frequency used by that agency. This would reduce problems with battery replacement, limited range, and operating multiple portable radios inside a communications or command van.

In addition, finding an available portable radio once on the scene may be problematic. If a specific frequency cannot be programmed into the multi-frequency radios supplied with the TRP-1000 unit, an older mobile unit can be quickly setup for use, negating the need for costly new units that may have minimal use.

3.3 Mobile Options - Trailer, Vehicle, Command Post

Jurisdictions have implemented many mobile deployment options. The most common include mounting the TRP-1000 in an enclosed trailer, placing it in a small utility vehicle, or installing it in a mobile command post. All of these options address a requirement for maintaining the mobility of the TRP-1000, and most provide for a platform from which to operate the unit.

Using a trailer to transport the TRP-1000 (as shown in **Figure 3-2**) is a low cost means of moving the unit from storage to event. Trailer configurations have been as simple as storing the unit in the back of an enclosed trailer with generators, a stash of radios, and the appropriate cabling. Some agencies have included a tent, folding table, and chairs in the trailer for extended operations.

Figure 3-2 Example of enclosed trailer used to store and transport the TRP-1000.

One of the drawbacks to a trailer mounted TRP-1000 is the need for a prime mover. Deployment plans for this arrangement must ensure that the designated prime mover is not already assigned to another task during an event. With this type of installation, the TRP-1000 must be configured either prior to departure, or on-site at the event.

Special consideration should also be given to the fact that the unit gives off a significant amount of heat, and it may not work correctly if used while still inside an enclosed trailer during a hot summer day. Use of an enclosed trailer as an operating platform should take into consideration the need for the operator of the unit to have a comfortable working environment, either in extremely hot or cold weather. The power supply should also be capable of providing supporting power to heat or air conditioning units inside the trailer.

Many jurisdictions have opted to place the TRP-1000 inside a dedicated communications vehicle using a van, command vehicle, or even converting a reserve ambulance as shown in Figure 3-3. Many configurations are possible with this arrangement and this can be an ideal solution if an agency has a spare vehicle to dedicate solely to TRP-1000 deployment.

Most of the vehicle configurations include strapping the TRP-1000 to the floor or side of the vehicle with a jump seat or bench for a technician to set-up and program the unit en-route. Some jurisdictions have designed the vehicle to supplement their command vehicle by moving their primary communications component from the command vehicle to the smaller TRP-1000 communications vehicle, and connecting the two via an intercom system.

Figure 3-3 Example of a TRP-1000 unit mounted in the back of a converted ambulance. The inside has been reconfigured with counters and chairs for communications technicians.

Commanders would likely benefit from moving the distraction of multiple radios operating simultaneously to an adjacent vehicle. One particular advantage to these designs is that they are typically airconditioned/ heated vehicles, especially an ambulance that has supplemental air conditioning. This makes operating the TRP-1000 much easier in the summer as the unit generates considerable heat when in operation.

One jurisdiction discovered having heat in the vehicle is also important as the TRP-1000 and radios did not put off sufficient heat to warm the van during a cold nighttime deployment. Some communications technicians also indicated operating the various radios over a wide temperature range caused frequency "drift" and recommended keeping the vehicle at a constant temperature, or checking the radios occasionally for drift. They emphasized that temperature changes do not affect the TRP-1000, but do affect the radios mounted in the unit.

The third common mobile deployment option involves placing the unit on a mobile command vehicle, typically a bus, motor home or large trailer as shown in **Figure 3-4**. Although space may be a consideration when deciding to implement this option, the co-location of the TRP-1000 with the other incident command resources can prove invaluable when manpower is at a premium. Since many mobile command vehicles already include communications and dispatch capabilities along with the necessary technicians and operators to run them, the TRP-1000 could easily be connected to and managed by these existing resources.

Figure 3-4 Example of a command post vehicle. A bigger vehicle allows more communications equipment to be carried to the scene alongside the TRP-1000.

Deployment plans for this arrangement can be restrictive, as it is necessary to deploy the entire command vehicle. There may be difficulties deploying the TRP-1000 to smaller events, or to long-term mutual aid assignments. One jurisdiction indicated that mounting the TRP-1000 in a command van would limit the ability to deploy the system off-road. However, like the previous option, this configuration allows for rapid deployment and on-the-fly set-up and programming while enroute to an incident.

3.3.1 Fixed-Site Operation - Communications Center, Backup EOC, and Dispatch

Some jurisdictions have integrated the TRP-1000 into their fixed communications and dispatch facility as shown in **Figure 3-5**. Others plan to use the unit as part of a backup emergency operations center. Since the TRP-1000 was designed as an interoperability solution, it does allow for the establishment of talk groups and patches between frequencies.

Figure 3-5 Example of fixed-site installation of TRP-1000 package.

Some agencies that dispatch by tone have worked on connecting their encoders to the unit as part of a backup dispatch package with varying degrees of success. However, since the TRP-1000 is restricted to analogue audio signals, it cannot facilitate computer-aided dispatch and other digital communications.

Although the TRP-1000 has many applications that benefit these arrangements, JPS Communications offers less expensive equipment to meet the needs of a fixed-site facility; the ACU-1000, which is essentially the internal components of the TRP-1000 without all the protective mounting and casings required for mobile operation.

Some jurisdictions have considered leaving the TRP-1000 in a mobile format and stationing it at the backup Office of Emergency Communications (EOC) or backup dispatch center where it would be connected to a suitable antenna system and power supply ready for immediate use. This configuration leaves the option of quickly disconnecting the system for rapid deployment.

Other jurisdictions are installing a power supply and antenna system at a preselected site to allow the installation of the TRP-1000 within minutes into a backup dispatch/repeater site. Still other jurisdictions are planning to use an existing fire station and radio tower to mount the antennas or to locate the antenna on a rooftop location in the downtown area to provide the greatest area of coverage in a backup configuration.

3.3.2 Mutual-Aid - Manned or Unmanned Deployment

Since most jurisdictions have mutual-aid agreements with neighboring jurisdictions, it makes sense to develop procedures and protocols for deploying the TRP-1000 to outside jurisdictions as needed. Some agencies have easily accomplished this by making additional units available for temporary or permanent loan to neighboring jurisdictions.

Other jurisdictions have opted to set-up the TRP-1000 for mobile configurations, and are working on creating plans to send the

unit to neighboring jurisdictions as needed. When considering the latter option, a jurisdiction must decide if they are going to deploy the TRP-1000 with trained operators and technicians, or simply drop-off the unit with all necessary equipment and provide a quick training session. If operators and technicians are not included in the mutual-aid package, then personnel from receiving jurisdictions should be included in relevant training and exercises. Agreements should be made ahead of time as to which jurisdictions will supply the necessary personnel, radios, connection wires, generator/power supply, etc.

Ideally, the trained operators and technicians from either jurisdiction would already have the necessary frequencies and radio information on hand, and could quickly program the unit to meet the needs of the event. Jurisdictions have mixed feelings on this issue. Some see their role as supplying the equipment and training to get the recipient jurisdiction up and running, while others feel leaving the system without a trained technician would be unacceptable.

3.3.3 Set-Up and Deployment En-route

Some jurisdictions have installed a mobile phone and fax capability in their TRP-1000 transport vehicles (typically in vans or command vehicles) so that a communications technician can contact the other jurisdictions and agencies while en-route to the event to obtain their radio frequencies and other information. In this scenario, the TRP-1000 can then be programmed with the correct frequencies and private line (PL) tones while another technician or operator is driving the unit to the incident. This also gives the technicians the ability to contact JPS Communications, Inc., or the radio manufacturers for technical information as needed.

Mobile phones can also be connected to the TRP-1000 for further interoperability capability. For example, mobile phone capability would let another local, state, or federal agency monitor scene communications from any location over their regular phone line, or allow the Incident Commander to speak with anyone by phone, simply by using their portable radio and having the TRP-1000 operator create the patch to the mobile phone.

Deployment plans can be relatively rapid in nature, as the necessary programming can literally be done on the move. If the system can be powered by an on-board power supply, direct current (DC), built in generator or similar system, the system could be operational even prior to arrival on the scene.

Note:
Additional electronic communication equipment compatible with the ACU-1000 Gateway Switch are: telephones, Internet audio transmissions, dispatch tones, marine radios, and aviation radios.

Because the TRP-1000 will accommodate virtually any device that produces or transmits audio, the potential of adding landline phones or some mobile phones to the system exists. For example, this allows the system to connect the Incident Commander's (IC) radio to any telephone in the world, simply by having the TRP-1000 operator patch the radio to the telephone module. JPS provides phone modules for the TRP-1000 system as part of the standard system.

Each jurisdiction needs to evaluate the methods available to communicate with all of the agencies that may be responding to an incident and plan to acquire appropriate radios or frequency/private line information to allow for interconnection capabilities.

JPS is finalizing development of their ViperNet™ system that will allow the TRP-1000 to be connected to an Internet system, vastly increasing the number of deployment and control options.

3.3.4 Creating On-Scene Talk Groups

An ideal usage of the TRP-1000 system is to allow similar units (such as HazMat

teams) from several jurisdictions, operating on separate radio systems, to be joined into a Talk Group, thus allowing the various tactical frequencies on the portable radios to be joined. This allows better communications on-scene, and takes radio traffic off the primary frequencies.

3.3.5 Making the IC's Job Easier

Ultimately, it is the ability of the TRP-1000 system to make the IC's job easier, which is its most desirable feature. The system, properly run by a skilled operator, will allow the IC to be connected directly to any other radio channel operating at the scene or to anyone via a telephone line anywhere in the world without changing the channel on their portable (or preferably the aide's portable radio).

A Unified Command Talk Group can be established to allow the heads of all of the relevant responding agencies to monitor or communicate on the command channel. Separate Tactical Talk Groups can be designated for various sectors as indicated above, and the IC can reach any of these groups quickly.

All that is necessary is to work out a system to alert the dispatcher to connect/disconnect the IC as requested, and to establish protocols for creation of tactical groups on scene. By allowing direct connection to multiple agencies and sectors, the IC can be far more productive, and get messages to the various agencies as needed. The system can aid in keeping the span of control within acceptable limits.

Other responders can request a patch to the IC through the TRP-1000 operator, which is terminated upon completion of the exchange of information, or can be left permanently connected.

3.4 Nomenclature Issues

Any time multiple jurisdictions are operating at the scene, the potential of having more than one unit using the same designation is present. For example, more than one unit designated as Tactical Unit 1, Medic 5, etc., can have disastrous consequences.

Several of the jurisdictions indicate these issues are addressed through statewide or regional agreements. However, agencies that have not addressed this potential beyond their immediate mutual aid system must do so. This issue should be addressed to assure the potential is minimized if only by requiring agency designation prior to unit number as a protocol for all mutual aid i.e., Jefferson County, Tactical Unit 1, or Medic 5.

3.5 Storage Recommendations

Consideration should be given to the issue of storing the TRP-1000 to minimize the potential of a terrorism incident taking out primary and backup communications systems at one facility. Jurisdictions with a single unit are advised not to locate the system at their main communications center, while those with multiple units should spread them out across the jurisdiction. Consideration should be given to using one or more units as part of a backup communications plan, and it is strongly recommended that the units be kept in their transportable configuration in order to take full advantage of the versatility this provides.

3.5.1 Disperse Storage to Minimize Vulnerability

Since a jurisdiction's primary communication center may be a target for terrorist activities, it is recommended that the TRP-1000 not be stored in the same location. If a jurisdiction is fortunate enough to have multiple units, it is recommended that they be distributed throughout the jurisdiction, or perhaps loaned to neighboring jurisdictions.

An example of well-planned dispersion of units would be to place one unit in a mobile configuration at a backup communications and dispatch facility, another in a location on the other side of the jurisdiction, and remaining units loaned to neighboring jurisdictions.

3.5.2 Stored as Pre-Deployed Backup Communications

Some jurisdictions have opted to use the TRP-1000 for backup communications in the event of a failure with their primary communications system. Others have setup their TRP-1000 as a mobile backup communications system that can be deployed at various locations within the jurisdiction that have been pre-identified as logical sites. This may be especially practical when a utility or command vehicle configuration is used for unit transport.

One of the advantages of using the TRP-1000 as part of a backup communications package is its ability to take old radios from a variety of manufacturers, using multiple frequencies, and combine them into a single system with perhaps two or three common channels. In this way, if a jurisdiction using an 800 MHz radio system encounters a system-wide failure they could switch to older 400 MHz systems and still operate with their existing infrastructure.

If the Fire Department still dispatches using audible tones or if its stations are still wired to receive those tones in addition to having been converted to a computer aided dispatch system, the TRP-1000 could carry those tones by simply connecting an encoder to the system.

3.5.3 Installed in Vehicles, Rack-Mounted For Optional Usages

Regardless of how a jurisdiction chooses to integrate the TRP-1000 into its response plans, it is strongly recommended that the unit remain in its transportable configuration. In addition to the shock-resistant features of the mounting configuration, the portable rack mounting allows for multiple rapid deployment options.

The system can be removed from the shock mounting system for permanent deployment in a communications center. However, "TRP" stands for "transportable." The ACU-1000 is the "non-transportable" version designed for permanent installation. Most of the agencies that have installed their units into vehicles for deployment intentionally left the units in the portable cases and secured the cases to the vehicle. This allows for rapid removal of the system for other deployment options and takes advantage of the shock resistance the portable cases offer.

The TRP-1000 is designed as a mobile communications tool that can be moved to the location of an incident and setup to establish interoperable communications for the scene. The unit is designed to use mobile radios (typically used in vehicles) with generic omni-directional antennas positioned nearby. Depending on the size of the jurisdiction, terrain issues, and antenna placement, it could be possible to provide interoperability between radio systems over a larger area without additional repeaters and antennas for each frequency on the system.

To illustrate the intent behind the design of the TRP-1000, consider a hypothetical jurisdiction responsible for 50 square miles of suburban population. This jurisdiction uses 15 frequencies on an 800 MHz trunked radio system that accommodates their daily operations. The Fire Department from a neighboring county is called in for mutual-aid to a large warehouse fire involving hazardous materials. Typically, the mutual-aid contingent using a low-band system would only be able to communicate amongst themselves at the fire scene. The TRP-1000 would enable them to integrate seamlessly into the response by providing access to the 800 MHz communications Talk Group using their own low-band portables and mobile repeaters.

4 TECHNICAL AND TACTICAL CONSIDERATIONS

4.1 800 MHz Misconceptions

Many jurisdictions are under the impression that an 800 MHz radio communication system solves interoperability problems, negating the need for an additional system. 800 MHz systems can incorporate units from neighboring jurisdictions if both systems have been programmed for that capability and both are operating on the same brand of 800 MHz radios. However, they have no capability to incorporate other agencies with other brands of 800 MHz radios, or radios on other frequency ranges.

4.1.1 Limitations of 800 MHz Systems at Large Scenes

While 800 MHz communication systems provide significant flexibility at emergency scenes, the system must be able to handle continuing dispatch requirements and other incidents simultaneously occurring within the jurisdiction. While the portable radios have a large number of frequencies available, the system usually has a limited number of Talk Groups that can be created before the system is overloaded. Many jurisdictions are already encountering overloaded 800 MHz trunked systems on a regular basis. The additional requirements of a major incident will likely result in ineffective communications within the existing system, and the inability of allowing communications with other "non-800 MHz" agencies.

4.1.2 Talk Groups

The TRP-1000 system has the capability of creating additional Talk Groups on scene by allowing the 800 MHz portables used in a Talk-Around mode to be connected with other agencies radios. The TRP-1000 has the capability of creating several simultaneous Talk Groups with any of the radios connected to it, or connecting all of the radios together simultaneously.

For example, putting all hazardous materials teams from across the region on one talk group (regardless of different radio systems) provides a tremendous benefit and will greatly enhance the potential for a positive outcome. A recommended practice is to create a Unified Command Talk Group with the heads of other responding agencies. The agency heads can access the Unified Command from their own command posts, or they can be patched into the command channel to monitor the incident via telephone.

4.2 Antenna Configuration Options

There are almost as many antenna configuration options as there are jurisdictions. Agencies currently using the TRP-1000 indicate antenna placement is not a problem and that frequency interference conflicts were usually simple to resolve.

4.2.1 Mobile Mounting, Rooftop, Portable Towers

Jurisdictions mounting the TRP-1000 in a mobile configuration have used a variety of antenna installations. Some use the magnetic, full-range units; others installed frequency specific antennae on a vehicle's rooftop (or on a ground plane attached to the rooftop).

Others mount a portable crank-up tower or pneumatic mast to the mobile unit to get greater coverage and separation capability for the antennas. One jurisdiction utilized the donation of a pneumatic mast from a media company that retired one of their mobile satellite trucks.

4.2.2 Temporary Magnetic Mount Antenna

The TRP-1000 systems have been supplied to the jurisdictions with several full-range magnetic mount antennas that work reasonably well for limited events. The magnetic mount units provide extreme flexibility in that the antenna can be placed almost anywhere and the system is operational in

minutes. The full-range antennae also reduce the potential of connecting the incorrect antennae to a radio that could damage the transmitter. Interference between radios is resolved by a slight adjustment of the antenna placement.

4.3 Fixed Facility Options

Several of the jurisdictions have installed fixed antenna units to allow the system to be operated as a semi-permanent installation that can provide greater coverage area, directional capability, and usually resolve any interference issues. In some cases, such as using the TRP-1000 as a backup repeater site, jurisdictions can install the needed antennae, provide a power supply, and bring the unit to the facility when needed. Some jurisdictions have one unit at their communications center to allow interconnection with other agencies (within range of the communications center) and to allow ease of initial training and refresher training for the operators.

4.3.1 Planning Deployment Options

Several of the extremely large jurisdictions have terrain problems that prevented a single TRP-1000 unit from covering their entire response area. By using maps of the jurisdiction, it may be possible to plan for coverage of the entire jurisdiction from a couple of strategically located sites.

In other cases, mobile deployment is the preferred solution with antennae mounted on the roof of the vehicle. Combinations of fixed facility installations, complemented with mobile units, are also possible. Taking advantage of existing antenna towers to place additional antennae for the TRP-1000 provides coverage of a large portion of the jurisdiction from a limited number of sites. New Vipernet™ technology from JPS Communications, Inc., will also allow remote operation of the TRP-1000 units from a central communications center.

4.3.2 Helicopter Deployment

A jurisdiction with extremely difficult terrain mounted the TRP-1000 in a helicopter for deployment over the incident scene to provide capability that could not be accomplished from a ground site. Other agencies have minimal need for helicopter deployment and would not wish to go through the re-balancing and re-certification needed to deploy multiple additional antennas and equipment on a helicopter.

4.4 Power Supplies

The TRP-1000 can run off 110V (volt) or 220V alternating current (AC) and 12V or 24V DC. Power supplies can range from vehicle batteries to portable generators or units can be plugged into a standard power jack in a nearby building.

4.4.1 Uninterrupted Power Supplies

When using an AC power supply, especially a generator, it is a good idea to consider placing one or more uninterrupted power supply (UPS) devices (depending on capacity) between the AC source and the TRP-1000. This is a relatively low cost means of protecting the electronic components of the unit, as a UPS will supply a continuous and regulated supply of power. UPS units are short life batteries that are constantly charged by the connected AC power supplies.

The TRP-1000 would then plug into the UPS device and be powered by the batteries. In this way, the TPR-1000 can remain operating for several minutes after the primary power source fails, allowing for the proper notifications and shutdown procedures to occur. The UPS device also serves to filter the peaks coming from a generator system. This prevents service interruptions if the generator runs out of fuel, or if the power cable is accidentally disconnected.

4.4.2 Generator Capacities

Most of the portable systems use portable generators in the 5-kilowatt capacity range, or carry (trailored behind the unit) multiple 5-kilowatt generators for a backup capability, as shown in **Figure 4-1**. Under most circumstances, this capacity is adequate.

However, in situations where all of the radios are "keyed" for simultaneous transmission, the generator circuit breaker may be tripped.

Figure 4-1 Two portable generators mounted on a trailer pulled by a van housing the TRP-1000 unit.

System loads should be calculated and the power supply systems engineered to allow adequate capacity. Adding heating or air conditioning units will likely place too high a burden on a portable generator system. Providing safe transportation and storage of backup fuel supplies and refueling of the generator units should be addressed where applicable.

4.4.3 DC Power Operation

While DC power is an option for using the TRP-1000 system, it requires bypassing the power supplies built into the system, along with considerable rewiring of the units, making it difficult to quickly reconfigure the unit for other deployment. Jurisdictions wishing to convert the system to DC operations should check to make sure the DC power supply (alternator) is adequate for running multiple radio systems simultaneously.

4.4.4 Onboard Generator Systems

A recent development in power supply systems for mobile equipment is the use of advanced generators operating off the vehicle's engine. These generators are capable of supplying up to 10 kilowatts of power output. These systems convert the idling engine speed to AC electrical supply stepping up the engine idle only as higher output is required.

The supplier of this patented system is Auragen, Inc., which has units available for most vehicles manufactured after 1996. The use of retired fire/rescue apparatus as mounting platforms for the JPS system may prevent use of these newer systems. These new systems may be an attractive option for minimizing setup time, noise, and generator maintenance. With a system installed in a mobile communications van, it may be possible to have the TRP-1000 operational prior to arriving on the scene.

4.5 JPS Corporate Support

JPS Communications, Inc. has pioneered the use of radio interoperability systems for use by emergency response personnel. They are committed to providing continuing customer support and further improvements to existing systems, as they are made available.

4.5.1 Cabling Issues

JPS has schematic diagrams available to any jurisdiction that needs to connect additional radios to the TRP-1000 system beyond the radios installed with the basic configuration. Some jurisdictions with communications technicians or specialists have the capability, and prefer to make their own cables. Other jurisdictions have requested JPS supply the completed cables. JPS has created a catalog of available connection cables available for purchase. (See Appendix for JPS Communications, Inc., contact information)

4.5.2 Initial Training and Set-Up

JPS will provide training and setup assistance to any jurisdiction purchasing the TRP-1000 systems. They are willing to assist with initial programming issues and to assure capable training is provided. (See Appendix for JPS Communications, Inc. contact information)

4.5.3 Software Upgrades

JPS will provide free software upgrades to existing systems as they become available. Users should contact JPS to determine if upgrades are available for their unit. (See Appendix for JPS Communications, Inc. contact information)

4.5.4 Assistance at Major Scheduled Events

JPS has provided local, state, and federal responders with major event deployments, including free technical assistance and training or operators for the unit as requested. (See Appendix for JPS Communications, Inc. contact information)

5 OPERATING SYSTEM MODELS

The following are examples of three communities that have established multi-agency interoperability communications systems using the ACU/TRP-1000 system. These communities have undertaken initial set-up and operation projects aimed at providing high performance multi-agency communications support for emergency response incidents.

These project models are presented here in order to demonstrate the extraordinary capability of the ACU/TRP-1000 system, and to provide insight and ideas to those developing their own high performance interoperable communications system. The examples cited do not represent the complete capability, nor all the possible options and configurations possible with the ACU/TRP-1000 system. However, they do demonstrate a dynamic and comprehensive approach to solving interoperability communications problems.

The projects selected are from three distinct types of jurisdictions. Those selected present a model from a very large metropolitan city, a large growing urban community, and a rural/ large city interface jurisdiction. The intent is to present ideas and examples covering a variety of settings, background, and terrains.

ODP recognizes that, although the project models described here are comprehensive, they are not perfect, nor are they the only jurisdictions with advanced or high performance interoperable communication system projects.

5.1 Chicago, Illinois Project

Chicago is the third largest city in the U.S. and has a population of nearly 3 million people. The Chicago metropolitan area covers an area of 228.5 square miles that encompasses the City and its surrounding suburbs and includes six counties in Illinois (Cook, Lake, McHenry, DuPage, Kane and Will). In 2000, the Chicago Fire Department responded to over 500,000 calls for help responding to various incidents involving people with emergency medical conditions as well as calls to preserve property. The department has six districts, 24 battalions, and a uniformed force of almost 5,000, including paramedics.

In 2000, Chicago acquired six TRP-1000 systems. Two units stay in the command center. Two units are reserved for deployment on an as-needed basis with neighboring jurisdictions. One has been installed in a surplus vehicle and the final unit will be similarly deployed. One of the mobile systems will be shared with federal agencies. The goal is to support 67 jurisdictions in the metropolitan area.

The City of Chicago's Office of Emergency Communications (OEC) is charged with providing 911/311 call answering and dispatching of Police/Fire/Emergency Medical Services (EMS) personnel within the corporate city limits of Chicago. The OEC also has the responsibility of transferring any calls for service received that require the response of a suburban public safety agency.

The OEC is responsible for staffing a Field Communications vehicle. The vehicle is operational on a 24 hour a day, 7 days a week basis and is staffed with an operator/driver and an electrical mechanic/ driver. Face-to-face relief at the incident scene allows for the continuity of communications services. The staff for the vehicle has been selected based on previous dispatch experience, effectiveness in following guidelines and procedures, knowledge of both fire and police dispatch operations and geographical knowledge.

The OEC, in conjunction with participating agencies, adopted a training manual consisting of specific modules involving these agencies and their operational concerns and practices. Training of the Field Communications vehicle staff took place at the OEC, and consisted of the pre-approved course along with specific training on the operations of the TRP-1000.

Each member of the Field Communications staff also received vehicle operation training, driver training, and training in the use of personal protective equipment. Classroom and drivers training lasted three weeks. Regularly scheduled in-service training coupled with drills and exercises supplement this formal training. The Field Communications staff "tours" with the Field Communications vehicle in order to provide on-site informational training to participating agencies.

The Field Communications vehicle is a refurbished 1992, Ford F350, with an ambulance body. The vehicle is equipped with a hydraulic extendible 50-foot tower that dramatically increases the range of the system. As shown in **Figure 5-1**, the components are still housed in their shock resistant cases for increased protection and mobility. These units can still be removed from the ambulance and installed elsewhere relatively quickly.

Figure 5-1 View of TRP-1000 mounted inside Chicago Fire Department's Field Communication Van.

The vehicle currently houses a JPS TRP-1000 interoperability system with five UHF and five VHF radios. The system has a file that tracks and logs connections of any phone numbers called as well as date, time and who connected or disconnected. OEC has also installed two 800 MHz radios, one 470-512 MHz radio, and one Motorola Low Band radio.

Data communications are currently handled by two Motorola MW520 mobile data computers with 1000 nit screens and one Microslate portable data terminal. The Field Com vehicle is also equipped with one mobile cellular phone and a fax/copy/printer. The vehicle carries 10 portable Motorola XTS3500 450 MHz radios, 10 spare batteries, and two Cadex C7000 Battery Conditioners/Analyzers.

The vehicle is equipped with its own onboard charging system and has a portable 5KW (kilo watt) gas generator that is carried on the rear tailboard to provide extended electrical power. The vehicle carries two 100 foot 12/3 electrical cables with quad boxes and two 25 foot 12/3 cables.

5.1.1 Chicago, Illinois TRP-1000 Deployment

The Chicago Fire Department is currently a member of the Mutual Aid Box Alarm System (MABAS). The system involves over 700 separate fire departments in Illinois, Southern Wisconsin, Northeastern Indiana, and Southwestern Michigan operating on over 100 different radio frequencies. Field Communications is scheduled to respond on all 2nd alarm, or greater calls, and will also respond on special requests for interoperability communications.

The Field Communications unit responds on all aircraft disasters and accompanies the Chicago Fire Department's mobile command center located at O'Hare Field. The command center responds to all aircraft disasters within 150 miles of Chicago. The Field Communications vehicle will fit in a C-130 (or larger) aircraft for transport if necessary.

Field Communications responds to all major power outages in the metropolitan area. The unit provides local public safety agencies with communications between themselves and other responders as well as local utility providers. Field Communications also responds on all requests for communications needs at the scene of marine incidents. Field Communications will respond

to hostage/barricade incidents. The unit also responds to all requests from suburban, county, and state law enforcement agencies involved in hostage/barricade incidents. The Field Communications unit responds on all level II, or greater, HazMat incidents.

On any given day in the City of Chicago, over 30 law enforcement agencies operate inside the city limits. Currently, none of these agencies can communicate with each other.

Additionally, the Field Communications unit responds and provides needed communications interoperability to the requesting agencies. It will NOT replace incident command at the scene, but will act as a clearinghouse for communications between agencies. Immediately following its deployment, the operating staff of the Field Communications is available for debriefing and critiquing of the incident. They prepare a formal report objectively outlining their participation in the event and forward the report to the Incident Commander.

5.1.2 Chicago, Illinois Operation Plan

The Office of Emergency Communications has verbal commitments from the Chicago Fire Department, Chicago Police Department, various city service agencies, the Illinois Department of Public Health, and the Chicago healthcare industry. They also have commitments from the MABAS (covering 700 fire departments), the Illinois Association of Chiefs of Police (IACP), the Community Fireman's Association (CFA covering 70 Fire Departments in Northern Indiana and Southwestern Michigan), FBI, ATF, and the US Army National Guard Civil Support Team (CST).

The Chicago OEC Multi Agency radio Interoperability Project (MARIP) team has just been given the results of a survey commissioned by the team on 75 surrounding cities in the Chicago Metropolitan Area. The survey was conducted by a team from the cities Executive Management School. The survey asked for each city to designate their main channel/s of communication (be they Fire/Police/EMS or Public Works) and to identify a channel that their departments could use as a secondary channel. This secondary channel will be designated their interoperability channel for the MARIP.

Our next step will be to begin the process of inviting each discipline in the project to a briefing. The disciplines will include Police, Fire/EMS, County, State, Federal, Military, Mass Transportation and Public Utilities/ Public Works. As an example - We will ask the Police Departments to appear and brief those with the program, and after a demo of the Field Com/TRP1000 ask them to select a 13 person representative committee (12 members and 1 Chairperson) to work on developing an operational plan for the vehicle. The time line for plan submission will be 3 months. After all the plans are submitted we will again meet with all the committee chairs and digest their reports to design a master plan. We project that by July 1, 2002, we will be ready for full implementation.

5.2 Orlando, Florida Project

Orlando is one of the fastest growing cities in America, presently encompassing over 105 square miles. The greater metropolitan Orlando area is made up of the City of Orlando and three counties (Orange, with a population of almost 850,000; Seminole, with a population of over 350,000 and Lake with a population of just over 200,000). By 2005, the area population is projected to grow to over 1.75 million.

Orlando acquired four (4) TRP-1000s. Their project plan re-deploys three of the units to the surrounding counties for their use. Orlando will inspect the units on an annual basis.

Orlando installed 800 MHz radios so the other jurisdictions would have interoperability with Orlando. They requested a radio from each of the other jurisdictions to install in the unit they kept to assure interoperability with each of the recipient jurisdictions.

Orlando configured all the systems before sending them out. Each system currently houses a TRP-1000 transportable module with five UHF and five VHF radios. Each system has a file that tracks and logs connections, disconnects and any phone numbers called as well as date, time and who connected or disconnected. The city has also installed two 800 MHz radios, one 470-512 MHz radio and one Motorola Low Band radio. They have Mosaic antennas for the UHF and VHF and they have two 800 MHz 5/8 wave antennas.

5.2.1 Orlando, Florida TRP-1000 Deployment

Orlando houses the TRP-1000 unit in the mobile racks to allow dispatchers to be more easily trained at their new communications center. They are exploring vehicle deployment options.

The City is also studying a mobile repeating option on a 50-foot tower, with four antennas mounted on an aluminum crossbar. With a van, they could use the "bigfoot" concept for raising antennas. They could use a disk antenna for low frequencies and a gain antenna for the 800 MHz spectrum.

They are setting-up the TRP-1000 for use as an emergency dispatch center and as a mobile repeater. They have identified a number of frequencies to be used in the new system. In an emergency, they would be able to use the unit to dispatch to the entire city. Currently, portable radios have a problem transmitting back to a single antenna location.

Note:
The following section was taken from the AGILE: City of Orlando Fire Department Mock Disaster Drill After-Action Report.

On January 13, 2001, the City of Orlando Fire Department (OFD) was involved in a mock disaster drill at Universal Studios in Orlando, Florida. The exercise included the City of Orlando Community Emergency Response Team (CERT) Association, City of Orlando Fire Department, and National Disaster Medical Systems (NDMS) Disaster Medical Assistance Team (DMAT FL-6). During this exercise, the fire department had the opportunity to utilize a TRP-1000 provided by the Department of Justice (DOJ) Office of Justice Programs (OJP), OSLDPS as part of a demonstration and assessment initiative. For this exercise, the TRP-1000 was used to link radio communications between the Orlando Fire Department and DMAT FL-6. The exercise simulated a tornado hit in an urban area and the response of community volunteers (CERT) coming to the aid of the 150 disaster victims. One hundred fifty children from an area high school were dressed in camouflage and acted as victims of the storm event. The victims were dispersed throughout a section of Universal Studios Florida. Victims were assessed and provided basic first aid by the 20 CERT teams participating in the event (8 people per team) and transported via stretchers to the DMAT. DMAT (a surgical field hospital) triaged and simulated treatment of 75 of these victims. The event lasted for five hours.

The TRP-1000s were initially configured with Bendix King VHF and UHF radios. The City of Orlando Police Department purchased five Motorola 800 MHz MCS2000s for installation into the four TRP-1000s. Through a multi-agency agreement, the 800 MHz radios were programmed with systems and talk-groups from neighboring jurisdictions as well as conventional NPSPAC interoperability channels. The Bendix King radios were programmed with frequencies utilized within the State of Florida for interoperability and disasters as well as Federal FEMA and NIC frequencies, which were also decided upon through multi-agency agreement.

Orlando Fire Department transported the TRP-1000 to Universal Studios and set up operations in close proximity to DMAT FL-6. The TRP-1000 was set up and connected to AC power from two outlets on the property. OFD set up the antennas several wavelengths apart utilizing some ice machines

and the vehicle as a ground plane. The set up time for the TRP-1000 was approximately 15 minutes.

After the initial setup of the TRP-1000, a test was conducted of the 800 MHz, VHF, and UHF radios with an OFD portable radio. Initial attempts to generate a net between the 800 MHz, VHF, and UHF radios, and any combination thereof, were unsuccessful. OFD personnel determined that the speaker button on the VHF and UHF radios was set up for PA function rather than speaker. After the radios were reprogrammed, the TRP-1000 successfully generated nets between the 800 MHz, VHF, and UHF radios without incident. After generating a test net, audio settings were adjusted to optimize performance; once initially set, the settings did not require any further adjustment during the exercise.

During the exercise, one of DMAT FL-6's 25 KHz UHF simplex channels was linked to a OFD 800 MHz talk-group. Once the software correction (described above) was accomplished, the TRP-1000 worked flawlessly. There were brief moments of cross talk and intermod. This was not due to any deficiency in the TRP-1000 but a symptom of being set up in a RF rich environment, coupled with the DMAT FL- 6 radios utilizing carrier squelch rather than selective signaling. At the conclusion of the five-hour exercise, the TRP-1000 was dismantled and stored for transportation in 15 minutes. Assistant Chief Robert Sorenson noted, "The TRP-1000 has tremendous potential for the City of Orlando and surrounding jurisdictions. The ability to network communications of several agencies utilizing different communications mediums in a field portable piece of equipment makes operational interoperability a reality. In this exercise, the TRP-1000 system has proven to be a reliable and useful piece of equipment."

5.3 Arapahoe County, Colorado Project

Arapahoe County, Colorado is one of the largest counties in Colorado with a population of more than 500,000. It adjoins the City of Denver to the south, covering an area of 850 square miles. Littleton is the county seat. The western part of the County is mostly urban with residential, retail, office, and industrial areas, while the eastern portion is relatively rural.

5.3.1 Arapahoe County, Colorado TRP-1000 Deployment

Arapahoe County has two TRP-1000 units. One is currently mounted in a converted prisoner transport van as shown in **Figure 5-2**. The county is purchasing a second van for the other unit that will have four wheel-drive capability and air conditioning. The unit is manned by telecommunications technicians and the van is available to go anywhere in the State of Colorado. There are two other technicians from neighboring counties that can be called upon to man the unit.

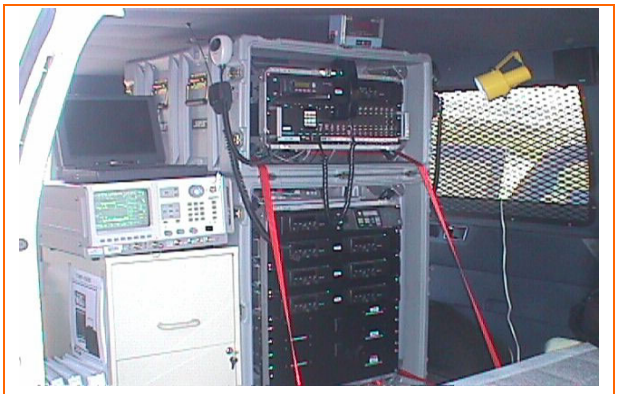


Figure 5-2 Inside view of TRP-1000 strapped into a modified Arapahoe County Sheriffs prisoner transport van.

The unit is equipped with 60 older VHF portable radios pre-configured for the interconnect system. These can be distributed at an emergency site to assure each team has a radio that can communicate with the command post. The TRP-1000 can be easily removed from the van for re-deployment to a higher elevation such as the top of a building.

There are also two additional units set up in separate vans. The TRP-1000 units are

attached via tie-down straps. There are 12 antennas on each van and two generators in a trailer that is towed by the vans.

Arapahoe County contacted the FCC and the state telecommunications offices to get a current list of frequencies being used by emergency response agencies. They used these to make a list of contacts and phone numbers for all responder agencies in Colorado. That information is carried on the unit as a reference.

The communications technicians have also equipped the van with schematic diagrams and common cable connectors to be able to interconnect other radios to the system while at the scene.

Power to the unit is supplied by two generators (one as backup) carried on a small flat bed trailer towed behind the van, or by extension cord hookup to any satisfactory outlet. The power supply is "filtered" through two uninterruptible power supply (UPS) units to prevent voltage spikes, and to guard against generator failure or inadvertent disconnection of the extension cord.

Problems encountered with their set-up occurred on a hot day during the TOPOFF 2000 Exercise. Communications technicians had to fine-tune the radios connected to the TRP-1000 because they started to drift off-frequency. They now plan accordingly for the heat and bring fans or crack windows as necessary.

Arapahoe County also notes that extreme cold temperatures can also cause radio frequency drift. To solve this problem, they are staffing the unit with radio technicians who can monitor and correct most radio problems. In the future, vehicles will be equipped with air-conditioning and heat to minimize this problem.

Plans include the addition of an Aluma 75-foot winch-up tower. The tower would be towed on a trailer.

Arapahoe County has informed other jurisdictions of their willingness to respond within the state in support of any major incidents. Arapahoe County has demonstrated the system on several occasions and has provided informational packets for other jurisdictions interested in the system.

APPENDIX A – POINTS OF CONTACT

The Office for Domestic Preparedness (ODP)

Point of Contact: Scott Kelberg
Email: mailto:kelbergs@ojp.usdoj.gov
Web Site: http://www.ojp.usdoj.gov/osldps

Point of Contact: Frank Lepage
Email: mailto:lepagef@ojp.usdoj.gov
Web Site: http://www.ojp.usdoj.gov/osldps

ODP State Domestic Preparedness Equipment Program

Although the jurisdictions identified in this user's guide obtained their ACU/TRP-1000 systems through a one-time ODP pilot project, acquisition of interoperable communications equipment is also an allowable expense under the ODP State Domestic Preparedness Equipment program. Additional information on this program may be obtained from the ODP web site at: http://www.ojp.usdoj.gov

JPS Communications, Inc, Corporate Support Information

Address:

JPS Communications, Inc.
5800 Departure Drive
Raleigh, NC 27616
Phone: 919-790-1011
Fax: 919-790-1456
E-Mail: mailto:jps@jps.com
Web Site: http://www.jps.com/

APPENDIX B – PARTICIPATING JURISDICTIONS

Point of Contact	Title	Agency/Location	Phone Number
Vince Whitmore	Chief	Fire Department Alexandria, VA	(703) 838-4600
Jerry Evans	Communications Operations Manager	Fire Department Salt Lake City, UT	(801) 799-3540
Thomas Bland	Special Agent	Federal Bureau of Investigations Atlanta, GA	(404) 679-9000
John Hughes	Telecommunications Specialist	Federal Bureau of Prisons Philadelphia, PA	(215) 521-7410
R.L. Sorenson	Assistant Chief	Fire Department City of Orlando, FL	(407) 246-3160
Kay Calhoun	Chief, Fire Communications Officer	Fire Department Baton Rouge, LA	(225) 389-4615
Richard Nowakowski	Project Manager	Office of Emergency Communications Chicago, Ill	(919) 790-1011
Craig W. Howe	Telecommunications Specialist	Arapahoe County Sheriff's Office Arapahoe County, CO	(303) 795-4998

APPENDIX C – LIST OF ABBREVIATIONS/ACRONYMS

Abbreviation/Acronym	Callout
AC	Alternating current
ACU/TRP-1000 systems	Used to generically refer to both the ACU-1000 and TRP-1000 systems
ACU-1000	ACU-1000 Modular Interconnect System
AGILE	Advanced Generation Interoperability for Law Enforcement
Aluma™	Aluma™ is a registered trademark of the Aluma Tower Company, Inc.
ATF	Alcohol, Tobacco, and Firearms
CERT	Community Emergency Response Team
CFA	Community Fireman's Association
CST	Civil Support Team
DC	Direct current
DMAT	Disaster Medical Assistance Team
EMS	Emergency Medical Services
FBI	Federal Bureau of Investigation
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
HazMat	Hazardous Material
HF	High frequency
IACP	Illinois Association of Chiefs of Police
IC	Incident Commander
JPS	JPS Communications, Inc.
KHz	Kilo hertz
MABAS	Mutual Aid Box Alarm System
MARIS	Multiple Agency Radio Interoperability System
MHz	Mega hertz
NDMS	National Disaster Medical Systems
NIC	Network Interface Card
NIJ	National Institute of Justice
ODP	Office for Domestic Preparedness
OEC	Office of Emergency Communications
OFD	Orlando Fire Department
OJP	Office of Justice Programs
PL	Private line
TRP	Transportable
TRP-1000	TRP-1000 Transportable Radio Interconnect System
UHF	Ultra High Frequency
UPS	Uninterruptable power supply
V	Volt
VHF	Very High Frequency
ViperNet™	Voice over Internet Protocol for the Extension of Radios over Networks. *ViperNet™* is JPS' proprietary technology embodied in a family of hard-ware and software products that enable communications radios to be interconnected via a network across the room or around the world. Voice over Internet Protocol, known as VoIP, is a means of digitizing voice sig-nals and transmitting them over a digital network, which can be a LAN, WAN or even the internet itself.