

## Section

## 1

## Executive Summary

## 1.1 Introduction

This project addresses one major topic and the subject is radio communications interoperability for first responders.

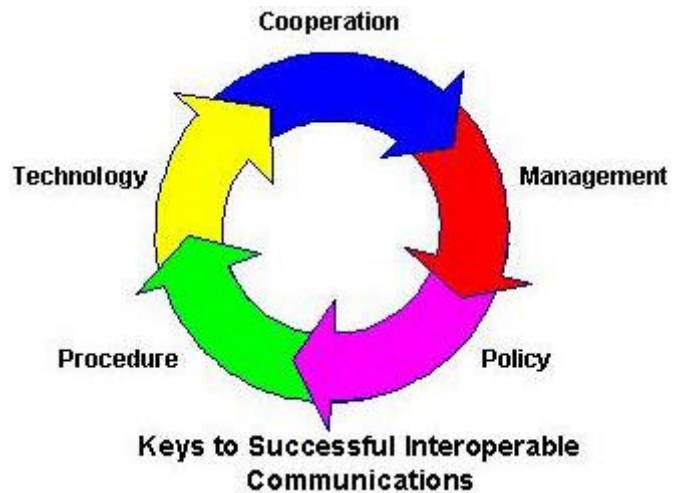
One definition of interoperability is "... the ability to exchange information quickly and accurately whenever and wherever the occasion requires...". Public safety and fire/EMS agencies have always recognized the need to be able to communicate, not only for day-to-day activities among their departments, but also with their neighbors, and other assisting agencies for those situations that call for a multiple agency response. In the past, because radio systems generally employed very similar technologies and the radio frequencies used were contained to a few radio bands, this was a simpler process, although not without some barriers. As technologies advanced with manufacturers producing what are essentially proprietary communications systems and new radio bands were made available by the Federal Communications Commission, the problem has become more complex. In fact, it is not uncommon even for a single city, with multiple departments, to face problems in engaging in radio communications across departments because of the various technologies and/or radio bands in use. When this condition is disseminated across an area with the diversity of the sixteen county region of the North Central Texas Council of Governments, the problem is greatly magnified.

Recognizing the issues, several agencies within NCTCOG have independently or collectively addressed many of the problem areas with varying degrees of success. One only needs to recall recent events: the Oklahoma City Murrah Building bombing, 9/11 in New York City, the Space Shuttle Columbia disintegration, the Fort Worth Tornado of March 2000, and so forth to acknowledge that there is a great need to effectively respond and manage the events that can and do occur. A valuable tool to be used in these situations is radio communications that can be applied rapidly and seamlessly and have the ability to support the increased radio traffic load that is the result of the incident.

The goal of this project is to undertake an assessment to understand the current level of interoperable communications that exists in the sixteen county region of the North Central Texas Council of Governments and make recommendations for improvements.

There are many technical strategies that can be applied to optimize communications, even though the regional environment is extremely varied as to the architectures and

technologies of the current radio systems, the frequency bands in use, and the operational processes being practiced. However technology is not the only portion of the puzzle. In fact there are other aspects that are more important as noted in the accompanying graphic, and these are Cooperation, Management, Policy and Procedure. Without cooperation no technical solution can be agreed upon and implemented. Without management no selected solution can be maintained. With no clear understanding and application of policy and procedure no solution will retain its vitality.



This report addresses a very complex situation and recommends a number of solutions that can be applied to the short or immediate term, to the mid range or intermediate term and finally a view into the future to address the potential long term solutions.

## 1.2 Report Structure & Scope of Work

The scope of work for the project is as defined in the contract executed by RCC and NCTCOG and is summarized below.

### **Task 1 - Project Initiation & Orientation**

The purpose of Task 1 was to initiate the project and conduct a project kickoff and orientation meeting to familiarize the NCTCOG's project team with the final scope of work for the project and with the project schedule, identify the types of information that will be requested from the participants, and establish appropriate lines of communication between the participating agencies.

### **Task 2 - Gather & Compile Data & Technical Parameters of Existing Radio Systems**

The purpose of Task 2 was to gather and compile data relating to the technical parameters of existing land mobile radio systems employed by the Public Safety entities in the sixteen county region served by the North Central Texas Council of Governments. The bulk of this information has been extracted from the Federal Communications Commission (FCC) Universal Licensing System Database and is included in soft copy format on CD-R media.

### **Task 3 - Determine Requirements for Day-to-Day User Agency Communications Interoperability and for Mutual Aid and Instant Command & Control**

The purpose of Task 3 is to determine the requirements for interagency communication, in essence, who needs to talk to whom and under what circumstances. In this regard RCC has conducted a number of group interview sessions or “Focus Meetings” during which the Public Safety agencies in each of the sixteen counties were invited to attend and participate. The purpose of the Focus Meetings was to clarify and refine information extracted from the FCC database, discuss current system and dispatching operations, and the extent of the need for interoperable communications with surrounding neighbors and throughout the NCTCOG’s region.

### **Task 4 - Develop Plan for Interoperable Communications**

The purpose of Task 4 was to assist the NCTCOG in developing a realistic and implementable interoperability plan that addresses immediate, intermediate, and long-term requirements. Recommendations for improvement have been developed in a modular or tiered approach, allowing each successive tier to build upon the previous one.

### **Task 5 - Prepare & Present Report**

The development of a Regional Interoperability Plan is a significant undertaking, which will require adequate planning and funding to fully develop and implement. The Phase I Report will become the foundation to help establish project direction and support the acquisition of adequate funding that will be needed to implement the recommendations.

This report is segmented into the following nine sections:

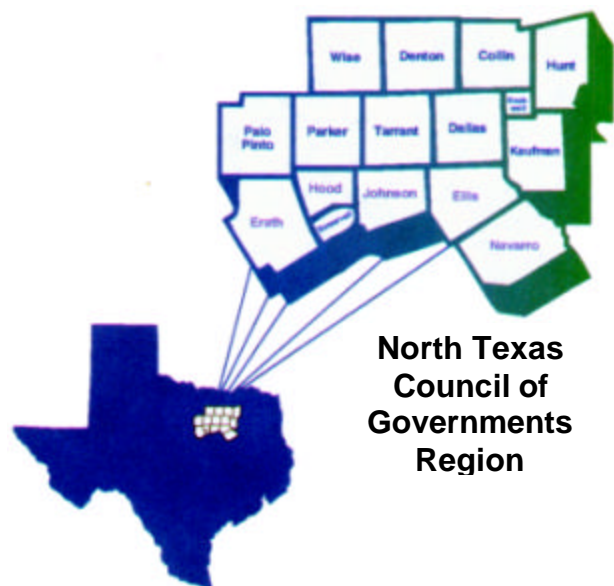
1. **Executive Summary** – Provides an encapsulation of the major items that are addressed in detail in the following sections. This section will benefit those that desire a summary overview of the project and the recommendations.
2. **Report Objectives & Structure** – Provides a high level discussion on the purpose of the project and the composition of the report.
3. **NCTCOG Demographics** – Provides background information regarding the counties, cities and associated law enforcement and fire/EMS agencies that have a need for communications interoperability.
4. **Existing Radio Communication Systems and Operations** – Discusses the current configuration of the NCTCOG located first responder radio systems and the operational aspects of these systems.
5. **Radio Spectrum, Technology & System Architecture Issues**– The potential impact of FCC actions are outlined along with a history of

- regulatory processes. A technology section is also included for those that may wish to review this information.
6. **Solutions and Recommendations** – An analysis of the system solutions along with RCC's recommendations is provided in this section.
  7. **Funding Sources for Interoperable Communications** – Sources of funding of interoperability communication solutions is discussed in this section.
  8. **Budgetary Cost Estimates** – Budgetary cost estimates are provided for selected solutions.
  9. **Appendix** – Contains various documents relating to the project including:
    - A. State of Texas Immediate Radio Communications Interoperability Plan
    - B. State of Texas "Incident Channel" Request Letter
    - C. NPSPAC Mutual Aid Radio Coverage Maps
    - D. Sample MOUs
    - E. FCC Database Information, with the actual database provided in "soft copy", i.e., CD-R media.

### 1.3 NCTCOG Demographics

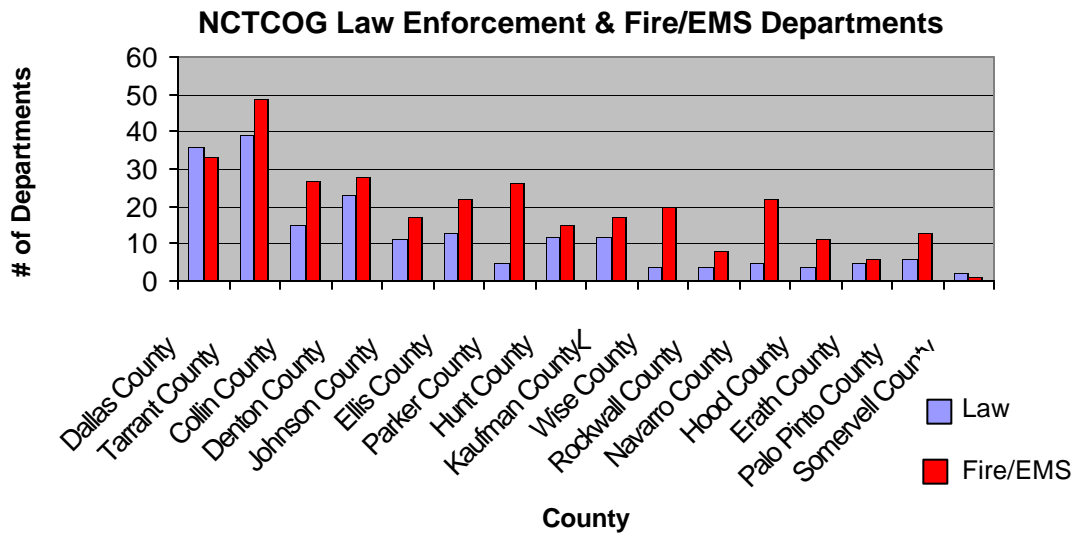
For the reader who may be unfamiliar with NCTCOG, a summary of the region from a broad perspective is included with a concentration on local government entities. State and federal agencies, as well as other entities are recognized as participants in the region interoperability assessment and are also addressed.

The North Central Council of Governments is comprised of a sixteen county region that exhibits a very wide range of diversity in terms of geographical scope and population. The five major metropolitan counties of Collin, Dallas, Denton, Tarrant, and Rockwall contain the bulk of the population totaling to over 4.7 million, while the remaining twelve counties' population totals to some three quarters of a million. From a geographic standpoint the physical size of the individual counties ranges from 129 square miles and 187 square miles for Rockwall and Somervell counties respectively, while the remaining counties range in size from over 700 square miles



to over 1000 square miles with a total geographic scope of over 12,370 square miles. As one would expect, the counties in the urban core have high population densities that range from over 2500 individuals per square mile in Dallas County to 400 individuals per square mile in Rockwall County. The remaining eleven counties starting with Johnson County and ending with Palo Pinto County have population densities that range from 181 individuals to 29 individuals per square mile.

For the entire region, the number of local law enforcement agencies and fire/EMS departments exceed 300 and 500 respectively. The chart below illustrates the distribution of law enforcement and fire/EMS agencies in the sixteen county region.



NCTCOG is surrounded by other Councils of Governments/Planning Regions. These include Texoma COG, Nortex Regional Planning Commission, West Central Texas COG, Central Texas COG, Heart of Texas COG, East Texas COG, and Ark-Tex COG. Many of these regions are examining individual communication interoperability plans. These plans can conceivably affect the interoperability operations of NCTCOG, especially for the bordering counties.

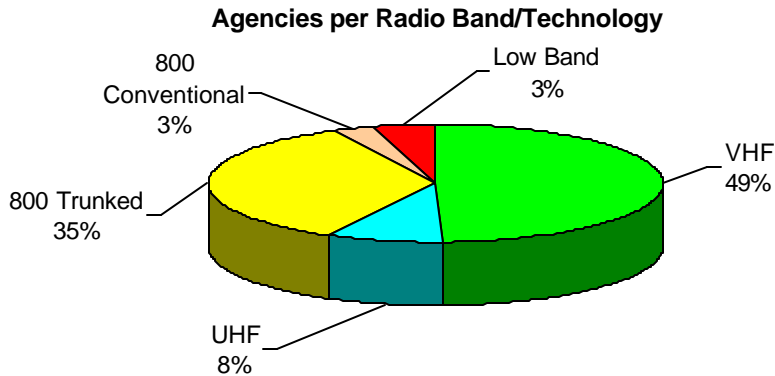
Another subset of agencies that can and do become involved in certain situations includes the both the state and federal government as well as emergency care facilities and related organizations.

**1.4 Current Radio Systems and Operations**

Understanding the extent and capability of current radio systems is an important aspect when exploring communications interoperability. Common systems lend themselves to relatively seamless interoperability solutions, while systems utilizing different technology or radio frequency bands pose a more difficult problem to solve.

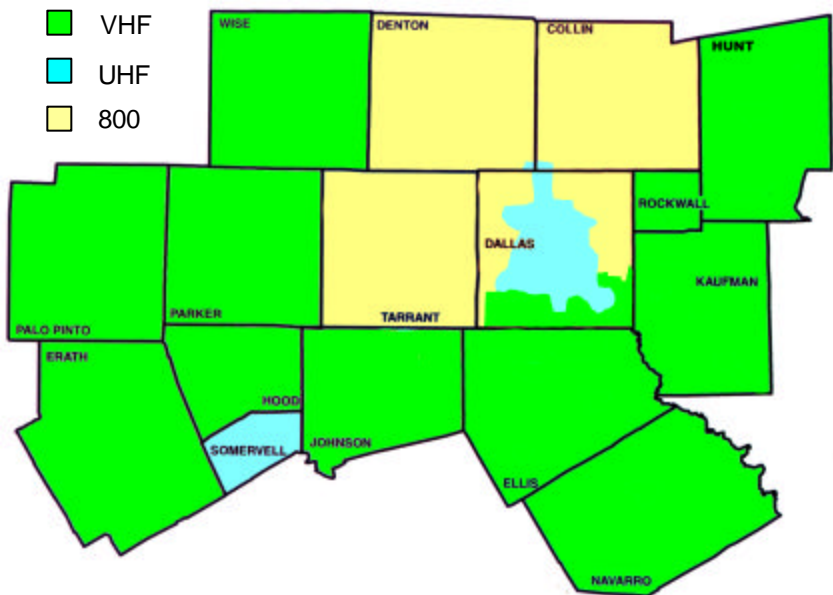
As one might expect, the variety of two-way radio systems utilized in the NCTCOG region parallels the diversity within the COG. The more heavily populated metropolitan areas generally utilize trunked radio systems that operate in the 800 MHz band, while the less urbanized areas tend toward use of conventional radio systems in the VHF and UHF radio bands. Many of these agencies hold various licensees in a number of radio frequency bands spanning the entire private land mobile spectrum including low band 30-40 MHz, VHF 150-170 MHz, UHF 450-470 & 470-512 MHz and 800 MHz 806-821/851-866 MHz. This report addresses what is considered the primary operating radio band used for day-to-day operations by first responders.

The chart below illustrates the number of agencies that use a particular radio band/technology.

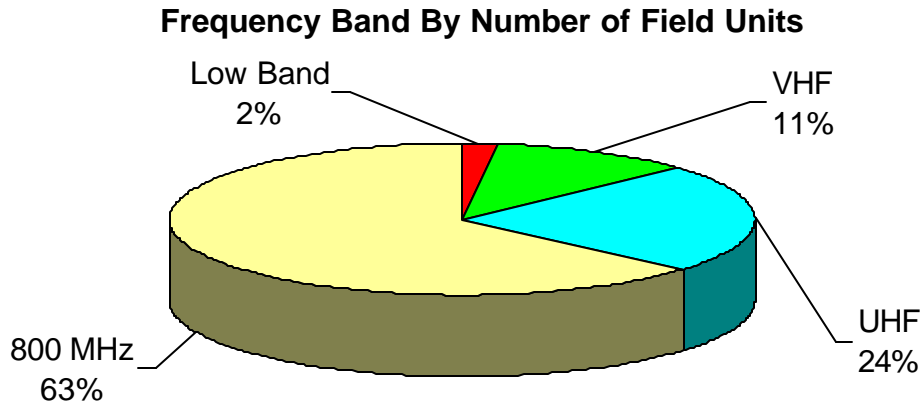


The geographic scope or extent of the systems that use a particular radio frequency band is noted in the picture below.

The map to the right portrays the distribution of the various radio bands within the individual counties and is based upon the predominant usage of the particular radio band by the first responder agencies in the sixteen county region. As one can see the VHF band is widespread in a large portion of the region, however 800 MHz systems are prevalent in the more heavily populated areas.



Another way of illustrating the usage patterns is to compare is the number of radio field units associated with the particular radio band/technology. This is illustrated in the chart below.



Using the information shown in the charts and pictures above, the following can be stated.

1. The VHF radio band predominates in the less urban areas of NCTCOG.
2. 800 MHz and trunking technology is the choice in most of the urbanized area of NCTCOG
3. The UHF radio band, although from a geographical scope, does not encompass a large amount of territory, however the number of radio field units surpasses that of the VHF systems.
4. Low band radio systems are not used as primary communications systems.

This information, which is a validation of what is recognized by the public safety/first responder community, will be used when considering solutions for providing interoperable communications. However, there are even more agencies that must be considered when exploring the total solution. These include the following:

- The counties that surround NCTCOG
- The State of Texas public safety agencies
- The Federal Government agencies
- Other service based entities such as the hospital networks

## 1.5 Radio Spectrum, Technology & System Architecture Issues

This report is of a technical nature and is written for those familiar with the terms common to wireless communications and land mobile radio systems.

The reader may wish to peruse certain portions of Section 5, especially if unfamiliar with the many technical terms that are used throughout the report. A "primer" on trunking is provided, along with a discussion on the system architectures that are employed in various designs. Readers who are more familiar with the technology and technical terms may wish to quickly review, or even pass over the section.

The first discussion point is a synopsis of the current state of the regulatory environment. Following this discussion is a more detailed view of the subject of radio spectrum and related issues. Those not familiar with this aspect may benefit from a review of this material.

Three key regulatory items currently have the most potential to affect existing and future radio systems, and in turn, how interoperability will proceed. These are:

- FCC Docket 03-34 - Impacts the radio bands below 512 MHz
- The 800 MHz Relocation Initiative - Can affect the entire Public Safety 806/851 and 821/866 MHz radio bands
- The 700 MHz radio band - Use of this new band has been slowed by a number of factors

On another but related front, the standards process, which is a user group lead initiative supported by a number of manufacturers, is striving to bring homogeneity to the technical standards that govern the way radio systems operate. The key goals include

- Maximizing radio spectrum efficiency
- Ensuring an open standard that produces non-proprietary equipment and systems
- Ensuring that a wide range of equipment suppliers are able to meet the technical requirements and produce equipment that will serve the users in the long term

Improved interoperability is one key result from standardization, however, even with this recognition, there are numerous elements that have affected the resolution of outstanding technical issues, which has slowed the process. Many manufacturers have introduced and continue to do so, systems and equipment that have proprietary aspects. With various systems employing disparate technologies, interoperability can be more difficult to obtain.

The report, in the following sections, examines technical as well as procedural solutions that can be used to overcome the barriers that prevent enabling of wireless communication interoperability.

## 1.6 Solutions and Recommendations

Solutions and associated recommendations are categorized into three stages. Immediate solutions are those that can be applied in a short time frame and are, in the general sense, likely to be the least expensive on a per agency basis. Intermediate solutions are those that can be more technically complex and may require the expenditure of more funds. Long term solutions look to the future, which is somewhat clouded by regulatory and technical complexities.

The categorization of the solutions is not firm. A short term solution can very possibly meet the mid and long term goals of an agency. A solution classified as intermediate may be implemented as an immediate solution, especially by those agencies that have already addressed the more straightforward means to enable interoperability.

Many of the solutions noted here are known by those who are familiar with the issues. In many cases, agencies in the sixteen county region of NCTCOG have applied these solutions with varying degrees of success.

The solutions offered here are generally technical in nature. But as noted earlier in this report, technology is only one part of the overall process. Without cooperation, management, and the setting of policies and procedures, no technology can be successful.

For the short term the solutions presented are:

1. Cooperative Usage of Existing Trunked Systems
2. Cooperative Usage of Existing Conventional Systems
3. Implementation of the State of Texas Immediate Interoperability Plan
  - A. Monitoring Texas Law 2 at Dispatch Centers
  - B. Monitoring Texas Law 2 at Other Locations
4. Optimization of the Current NPSPAC Mutual Aid Channels
  - A. Management of Current NPSPAC Mutual Aid Channels
  - B. Enabling RF Control Stations at Emergency Care Facilities
  - C. Enabling RF Control Stations in Mobile Command Vehicles
5. Deployment of NPSPAC Mutual Aid Channels Region Wide
6. Implementing Communications Console Patches
7. Implementing Hardware Patches
8. Exchanging Radios
9. Utilizing Multiple Mobile Radios

## 10. Utilizing Commercial Services

For the immediate term the recommendations are as follows:

1. Implement a coordinated region wide radio field unit programming initiative for 800 MHz trunked systems so that radio field units can operate in any of the manufacturer specific trunked systems. As part of the trunked system programming initiative ensure that radio field units include, not only interoperability talkgroups, but also the NPSPAC mutual aid channels as well as the Incident Control channels.
2. For VHF conventional systems, ensure that radios include the State of Texas Immediate Radio Communications Interoperability Plan channels and those channels of other VHF systems within the COG as well as the counties that surround the COG; with the understanding there are hardware limits for some radio units.
3. Ensure that all dispatch centers in the region have the capability to monitor, at a minimum, the Texas Law 2 channels as recommended by the Texas Immediate Interoperability Plan.
4. Optimize the operating procedures and policies in regards to the NPSPAC mutual aid channels of existing stations
5. Deploy the NPSPAC channels in those areas not currently equipped to allow 800 MHz radio units to operate in those areas.
6. Deploy console patches or hardware patches region wide to enable the interconnection of dissimilar systems.
7. Ensure that emergency care facilities are equipped with radio equipment capable of operating nearby 800 MHz trunked systems and the NPSPAC mutual aid channels
8. Ensure that emergency care facilities are equipped to monitor the Texas EMS channels per the state plan.
9. Consider a plan for augmenting operations through the distribution of loaner radios to agencies responding to an incident.
10. Consider on a per agency basis, the provisioning of multiple radios in certain vehicles or apparatus
11. Consider the use of commercial services to augment incident communications, with the understanding that this action will be more effective if these communications can be patched to the land mobile systems in the area.

Given that many of the solutions noted above require a very high level of agency cooperation, further discussions among the parties is strongly recommended before steps are taken to implement them. With this in mind, and understanding that there is a need to quickly enable a higher degree of interoperability than exists today, RCC

has selected a solution that can be implemented somewhat independently. This approach calls for the deployment of equipment that will allow the interconnection or patching of dissimilar radio systems on a per agency basis. The deployment of this equipment is subdivided into two portions. One deployment is for the generally urban counties of Collin, Dallas, Denton and Tarrant. The second deployment is for the generally less urbanized counties of Wise, Palo Pinto, Erath, Hood, Somervell, Ellis, Navarro, Kaufman, Rockwall, and Hunt. The details of all of the suggested interoperability solutions are discussed in detail in Section 6 of the report.

For the mid term the solutions presented are:

1. Utilizing System Networking
  - A. Utilizing Network Gateways
  - B. Expanding Existing Networks
2. Implementing Consolidated Dispatch
3. Provisioning Communications Incident Command Vehicles
4. Implementing Interoperable Mobile Data

The intermediate solutions are somewhat more technically complex, and generally require multi-agency involvement. Participation of the municipal and county governments as well as the management staffs of the first responder agencies is a very important ingredient in these undertakings.

For the intermediate term the solutions explored are:

1. Networking of the various two way radio system present in the region
2. Communication incident command vehicles
3. Consolidated dispatch centers
4. Interoperable mobile data communication systems

The first two of the four approaches categorized as intermediate lend themselves as a bridge between solutions that can be implanted relatively quickly and the future technologies, which at this point holds some unknowns. The intermediate network solutions can be modified and adapted to interconnect new system types and frequency bands, while mobile command vehicles can be outfitted with new equipment to accommodate changes in technologies.

The concept of regionalized or centralized dispatch is less of a challenge with regard to technical issues when compared to the organizational, management and operational concerns and can be a politically charged process.

In the somewhat the same vein, region wide Interoperability for mobile data systems can be a complex undertaking, depending upon the level of services and the number of agencies that are to be accommodated in an interoperable mode.

Given the potentially very involved nature of any intermediate solution RCC's recommendation is that NCTCOG take the solutions offered here under further review and study and seek comment from the first responder agencies of the region.

For the long term, the discussion centers upon the following:

1. The 700 MHz band
2. Wideband Data Applications
3. Integrated Wide Area Systems

Due to the many complexities in the regulatory and technical arenas, the discussion centers not directly on solutions, but technological advancements that can aid interoperability. These include:

- Compatible Multi-Functional Radios & Systems
  - Multi-Mode/Multi-Band Subscriber Units
  - Software Defined Radios
  - Wireless LAN Technology
- Integration of Commercial Wireless Networks with the Public Safety Systems

The discussion of long term interoperability solutions is a view into the future, which is somewhat clouded since many of the concepts are directly impacted not only by the continuing technical standards processes, but also by the decisions pending from the Federal Communications Commission.

A common factor for many of the technical solutions is that some level of cooperative agreements will be required among the agencies deploying interoperable communications solutions. As part of the report, sample Memorandums of Understanding that can be used as a template to execute agreements between the various public safety agencies are included in the Appendix of the report.

## 1.7 Funding Opportunities

Due to the complexity of the various programs, and the potential for extended implementation times for the various stages of interoperable communication solutions, various funding sources should be identified to help support the NCTCOG Region Wide Communications Interoperability Project. Federal, State and Foundation grants can be a significant source of additional funds for the project.

RCC recommends that under the authority of NCTCOG, a Grant Application Subcommittee pursue the identification of funding sources as they evolve in the coming years and to facilitate preparation of applications for grant funding to support the goals of the project.

RCC has identified some sources that may be applicable for programs that are implemented starting next year.

**1.8 Budgetary Pricing for Recommended Solutions**

RCC has provided budgetary pricing for certain solutions. The application of each of the solutions is somewhat involved since the application is directly related to each agency's level of participation as well as the technical aspects of the currently operating systems.

Actual purchase of the equipment and/or systems will generally result in more advantageous pricing than indicated here, as manufacturer suggested list pricing is used in the estimates. More favorable pricing may be obtained by taking advantage of state and local government programs or via the federal government's General Services Administration (GSA) contract. Results from the generation and publication of competitive Requests for Quotations (RFQ) or Requests for Proposals (RFP) can be attractive as well.

The total price of each solution, which includes the equipment and implementation costs, is provided for selected scenarios. Given the many variables that can be associated with each solution, the general case is given.

A summary of the pricing for the Immediate Solutions is noted below. The reader is encouraged to examine Section 8 for details related to each pricing scenario.

Item	Budgetary Price	Notes:
Radio Programming	\$55	Per Radio Unit - See 8.2.1
State of Texas Interoperability #1	\$8,200	Per Location - See 8.2.2
State of Texas Interoperability #2	\$22,000	Per Dispatch Location - 8.2.2
Remote Repeater Control of NPSPAC Stations	\$10,800	Per Dispatch Point -See 8.2.3.1
NPSPAC Repeater System	\$93,000	Per County - See 8.2.3.2
Enabling NPSPAC Radio Channels at a Mobile Command Post	\$74,000	Per Command Vehicle - See 8.2.3.3
Enabling 800 MHz Control Stations at Emergency Care Facilities	\$8,800	Per Location - See 8.2.3.4

Item	Budgetary Price	Notes:
Console Patch - (Central Electronics Only)	\$5,000	Depends upon console configuration - See 8.2.4
Hardware Patch - Link TCB-1	\$900	Application Specific - 8.2.5
Hardware Patch - Vega VIPER 12	\$16,500	Application Specific - 8.2.5
Hardware Patch - Communication Applied Technologies ICRI	\$8,000	Application Specific - 8.2.5
Motorola Lyrix 2001	\$2,700	Application Specific - 8.2.5
Hardware Patch - Raytheon/JPS ACU-1000	\$22,650	Application Specific - 8.2.5
Exchanging Radios	\$1,000 to \$4,000	Depends upon model & features - See 8.2.6
Utilizing Multiple Mobile Radios	\$2,000 to \$4000+	Depends upon mode & features - See 8.2.7
Utilizing Commercial Services	Negotiable	Depends upon service plan - See 8.2.8

Each of the solutions presented above can be applied in a number of ways. Some of the solutions, because of the nature of the implementation, will require additional discussion among the participating agencies. Details will have to be worked out regarding technical, operational and management issues. Therefore, in order to present one solution that can be applied relatively quickly and somewhat independently on a per agency basis, RCC has selected one approach that can be applied universally in the region. This solution calls for the use of equipment that allows the interconnection of various radio systems. The equipment is to be located at designated Public Safety Answering Points throughout the region. Using the equipment, each agency will be able to interconnect disparate radio systems that operate in their service area and allow the radio units of the different agencies to converse with each other.

The equipment complement for the solution includes the following:

1. A "hardware patch" such as the ACU-1000
2. Specified new radio equipment and accessories that will provide the air-link to the various radio systems

The expected cost of the solution, which is detailed in Section 8 of the report totals to **\$3,733,600** for the four urban counties and includes some fifty-two agencies. For the twelve remaining less urbanized counties the expected cost of the solution totals to **\$2,312,000** for some twenty-five agencies. The total budgetary cost is **\$6,045,600** for the entire region. This figure is based on the premise that all identified agencies will take advantage of the program and implement the solution.

Pricing scenarios for the Intermediate Solutions are more limited given that the various approaches have a much higher degree of complexity, both in technical scope and application than the immediate solutions. Accordingly any pricing that could be applied would be very broad in nature, and yield little usable information. Of the four solutions examined: 1) System Networking 2) Communication Command Vehicles 3) Consolidated Dispatch and 4) Interoperable Mobile Data only the Command Vehicles are assigned a budgetary price.

No attempt is made to provide pricing for the Long Term Solutions as this discussion is based on concepts.

## 1.9 Project Implementation Plan

The process to move the project forward includes a number of individual action areas, some of these are noted below.

1. Complete the review of RCC's report and identify additions and or modifications
2. Review and achieve consensus of recommendations
3. Communicate these additions, modifications and recommendations to RCC
4. Review the final report after delivery by RCC
5. Convene a meeting of the interested parties to present findings of the report
6. Determine the region's position concerning the recommendations
7. Convey the region's position to the Department of Justice
8. Meet with the DOJ to discuss funding arrangements

Due to the involved nature of any potential implementation, RCC offers it services to assist the North Central Texas Council of Governments in any further stages of the project.

The reader is encouraged to review the rest of the report, which contains some level of detail and supporting documentation for each of the subject areas.