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# TABLE OF CONTENTS

**PREFACE**................................................................................................................................. v  

**INTRODUCTION**.......................................................................................................................... 1  
  - SECOND-TIER PLANNING........................................................................................................... 1  
  - SAMPLE GUIDELINES FOR REGIONAL EMS SYSTEM DEVELOPMENT .................................. 5  
  - SCOPE...................................................................................................................................... 5  
  - TERMINOLOGY ......................................................................................................................... 6  
  - EMS ORGANIZATION AND MANAGEMENT .......................................................................... 6  
  - HUMAN RESOURCES AND TRAINING ..................................................................................... 7  
  - EMS FACILITIES AND MEDICAL DIRECTION ....................................................................... 8  
  - EMS TRANSPORTATION .......................................................................................................... 9  
  - EMS SYSTEM EVALUATION .................................................................................................... 10  
  - EMS COMMUNICATIONS ......................................................................................................... 10  

1. **WRITING THE REGIONAL EMS PLAN INTRODUCTION** ......................................................... 21  
2. **DEFINING THE REGIONAL ORGANIZATION** ...................................................................... 23  
3. **CURRENT EMS COMMUNICATIONS STATUS** ................................................................. 25  
4. **DEFINING REGIONAL GOALS AND OBJECTIVES** ............................................................ 29  
   - PERFORMANCE OF THE EMS COMMUNICATIONS SYSTEM ............................................. 30  
   - INTERFACE TO OTHER EMS COMMUNICATIONS SYSTEMS ......................................... 30  
   - INTERFACE TO OTHER TYPES OF COMMUNICATIONS SYSTEMS .................................. 31  
   - USE OF COMMON RESOURCES ....................................................................................... 31  
   - AWARENESS OF THE EXTERNAL ENVIRONMENT .......................................................... 31  
   - PROGRAM MANAGEMENT ................................................................................................. 31  
5. **ANALYZING REGIONAL REQUIREMENTS** ........................................................................... 33
6 EVALUATING REGIONAL ALTERNATIVES ..................................................... 39
   SYSTEMS DESIGN CONSIDERATIONS .......................................................... 39
   TWO-CHANNEL VHF BASE STATION ......................................................... 41
   TELEPHONE INTERCONNECTED BASE STATION .......................................... 43
   BASE STATION CONTROLLED BY RF OR MICROWAVE LINK .................... 44
   VHF AMBULANCE INSTALLATION ............................................................... 45
   MULTI-CHANNEL UHF BASE STATION ........................................................ 46
   MULTI-CHANNEL UHF MOBILE RELAY (REPEATER) BASE STATION .......... 47
   UHF AMBULANCE CONFIGURATION ......................................................... 48
   UHF VEHICULAR REPEATER ....................................................................... 49
   SITE SELECTION .......................................................................................... 52
   SYSTEM COORDINATION .......................................................................... 55
   SITE ENGINEERING ..................................................................................... 56

7 DESIGNING THE REGIONAL SYSTEM ......................................................... 65
   EXAMPLE OF SYSTEM DESIGN ................................................................. 65

8 DEVELOPING A PROCUREMENT PLAN ...................................................... 71
   PROCUREMENT PROCESS CONSIDERATIONS ............................................. 71
   TYPE OF PROCUREMENT .......................................................................... 73
   BID PACKAGE .............................................................................................. 73
   EVALUATION OF BIDS ............................................................................. 75
   NEGOTIATIONS AND CONTRACTING CONSIDERATIONS ............................ 76

9 DEVELOPING A FUNDING PLAN ................................................................. 81
   RESOURCE REQUIREMENTS ....................................................................... 81
   IDENTIFICATION OF RESOURCE SOURCES .............................................. 82
   PROJECT BUDGET ...................................................................................... 82
   FINANCIAL MANAGEMENT SYSTEM .......................................................... 83

10 DEVELOPING AN IMPLEMENTATION PLAN ............................................. 85
   STATEMENT OF WORK .............................................................................. 85
   SCHEDULE .................................................................................................. 86
   ASSIGNMENT OF RESPONSIBILITY .......................................................... 86

11 DEVELOPING PROCUREMENT SPECIFICATIONS .................................... 87
   PREPARATION OF SPECIFICATIONS ........................................................ 87
   ELEMENTS OF A SPECIFICATION ............................................................ 88
   GENERAL INFORMATION .......................................................................... 88
   ORGANIZATION OF BID PACKAGES ....................................................... 88
   NOTIFICATION OF SOLICITATION .......................................................... 89
   BID PACKAGE CONTENTS .......................................................................... 89
   LEGAL ADVERTISEMENT ............................................................................ 89
   BID FORM .................................................................................................. 89
   PROPOSAL REQUIREMENTS ...................................................................... 89

NATIONAL ASSOCIATION OF STATE EMS DIRECTORS
PLANNING EMERGENCY MEDICAL COMMUNICATIONS

GENERAL INSTRUCTIONS AND CONDITIONS .................................................. 90
EQUIPMENT LIST ............................................................................................ 90
GENERAL SYSTEM REQUIREMENTS .............................................................. 90
SYSTEM DESCRIPTION .................................................................................. 90
EQUIPMENT SPECIFICATIONS ....................................................................... 90
FACILITIES SPECIFICATIONS ......................................................................... 90
INTERFACE SPECIFICATIONS .......................................................................... 91
TRAINING SPECIFICATIONS .......................................................................... 91
DOCUMENTATION SPECIFICATIONS ............................................................. 91
TEST AND ACCEPTANCE REQUIREMENTS ................................................... 92
VENDOR RESPONSIBILITIES .......................................................................... 93
EXISTING SYSTEM INFORMATION ................................................................. 94

APPENDIX A - PROCUREMENT PROCESSES .............................................. 97
INVITATION TO BID (ITB) OR REQUEST FOR BID (RFB) ............................... 97
LOWER BIDDER IF TECHNICALLY ACCEPTABLE ......................................... 97
TWO-STEP REQUEST FOR PROPOSAL ......................................................... 98
MODIFIED TWO-STEP ................................................................................... 99

APPLICABLE DOCUMENTS .......................................................................... 100

INDEX .......................................................................................................... 103
PREFACE

Planning Emergency Medical Communications is presented in two volumes. Volume One, *State-Level Planning Guide*, contains background information and details pertaining to the "two-tiered" approach to EMS communications planning. The first-tier plan focuses on factors necessary to ensure system compatibility, interface and coordination of local EMS communications within a statewide system.

Volume Two, *Regional-Level Planning Guide*, provides more specific information and directions for use by local planners in preparing detailed second-tier local emergency medical telecommunications plans.

It is impossible for a document such as this to convey all of the information needed regarding emergency medical communications or to keep up with continuous change in communications technology and regulations. Changes to the Federal Communications Commission's Rules directly influence the system configurations and use of the radio frequency spectrum. The types of equipment offered by manufacturers constantly change, and there also are frequent changes in funding and federal, state and local policies. These all influence the EMS communications-system-design philosophy. EMS communications, as with most modern communications, are being constantly developed and improved.

Throughout this document, references are made to the "state office of emergency medical services" (state OEMS). This generic term refers to the appropriate official agency responsible for regulating emergency medical services within state government.
PLANNING
EMERGENCY MEDICAL COMMUNICATIONS

Volume Two

LOCAL/REGIONAL-LEVEL PLANNING GUIDE

INTRODUCTION

SECOND-TIER PLANNING

Volume Two of this planning manual is concerned with development of regional and local level plans. It is more of a "how to do" manual providing assistance and direction for regional and local planners in preparing detailed second-tier regional emergency medical services (EMS) communications plans.

This approach to planning is patterned after the ASTM Standard Guide for Emergency Medical Services System (EMSS) Telecommunications Standard F1220-89\(^1\). The ASTM standard sets state planning goals and objectives and advocates applying a two-tiered approach for EMSS communications planning.

Under the two-tiered approach, a general guide or overall first-tier state plan identifies the communications goals and factors that need to be coordinated statewide. Local second-tier EMSS communications plans are then prepared in accordance with the statewide guideline plan. The local plans are tailored to satisfy local system needs while providing communications compatibility and interoperability with other emergency medical services within the state. This is accomplished by adhering to the compatibility factors provided in the statewide plan.

In most states, EMS systems and EMS communications already exist and are operating. There is no need for all regional plans to be prepared immediately or simultaneously. Instead, regional plans are prepared as the need arises for significant system improvements or conversions in particular areas. The EMS planning in each region most likely will have to be examined, reorganized and revitalized at the time planning begins.


NATIONAL ASSOCIATION OF STATE EMS DIRECTORS
Figure 1 outlines the overall planning process reflected in this manual. Each of the steps in the process corresponds to a chapter in the manual and plan:

- **Sample Guidelines for Regional Emergency Medical Services System Development**, provides guidelines for all components of an Emergency Medical Services System (EMSS).

- **Chapter 1, Writing the Regional EMS Plan Introduction**, describes the necessary introductory identifications and background information.

- **Chapter 2, Defining the Regional Organization**, assumes that the planning organization has been reactivated and consolidated, and so provides for a description of that organization and other related organizations.

- **Chapter 3, Current EMS Communications Status**, describes how to define the planning area and develop an inventory of communications resources.

- **Chapter 4, Defining Regional Goals and Objectives**, discusses the hierarchical relationship of goals, objectives and implementing programs and lists some areas to be considered in the definition of goals and objectives.

- **Chapter 5, Analyzing Regional Requirements**, describes how to compare the current status against the goals and objectives to identify specific current needs.

- **Chapter 6, Evaluating Regional Alternatives**, covers the identification and evaluation of system design alternatives and the selection of the best alternative. A number of model system configurations are provided and discussed.

- **Chapter 7, Designing the Regional System**, covers the development of the selected design concept and provides an example.

- **Chapter 8, Developing Procurement Specifications**, describes how to document the system design in a format suitable for inclusion in Requests for Proposals or Invitations for Bids.

- **Chapter 9, Developing a Funding Plan**, covers the identification of potential funding sources and the coordination and control of funds for the project.

- **Chapter 10, Developing an Implementation Plan**, describes the tasks to be completed after the initial planning has been carried out.

- **Chapter 11, Developing a Procurement Plan**, describes how to incorporate the technical specifications into the comprehensive bid documents and how to organize and control a complex technical procurement.
All of the chapters include checklists of specific steps and items to be accomplished.
Figure 1 The Planning Process
SAMPLE GUIDELINES FOR REGIONAL EMS SYSTEM DEVELOPMENT

This chapter acknowledges the relationship between the regional EMS plan and EMS communications planning efforts. Whether the regional communications plan exists as a separate document, or as an integral part of the regional plan, it should be established within the overall structure of the regional EMS plan. Since appropriate communications system development depends on interaction with these other EMS component areas, suggestions are made within this chapter to address these considerations. This chapter is a sample outline for a plan and status evaluation for the emergency medical service systems and related EMS communication. It is included here as an example and therefore does not address in depth all of the components or considerations required of a total EMS system plan. It has been deliberately focused on the communications aspects of the EMS plan.

GUIDELINE FOR REGIONAL EMERGENCY MEDICAL SERVICES SYSTEM DEVELOPMENT
(sample)

SCOPE

This document establishes guidelines for the development of regional EMS systems in the state and identifies the minimum levels of performance that every regional EMS system should meet.

This guideline should be used to identify goals for the regional EMS system and to develop an annual plan of work with specific objectives to meet those goals.

The plan is divided into sections that correspond to the major components of an EMS system. These include:

- Organization and Management (regulation and policy)
- Human Resources and Training
- Facilities
- Medical Direction
- Transportation
- Public Information and Education
- EMS System Evaluation
- Trauma Systems
- Resource Management
- Communications
TERMINOLOGY

Region - An organizational unit utilizing established geographical boundaries for the purposes of planning, developing and coordinating an EMS system.

Regional EMS Council - A planning and coordinating body for regional EMS system development. Membership should include all of the various elements involved in an EMS system.

Regional EMS Plan - A written document identifying the strengths, weaknesses and prioritized goals for the growth of the regional EMS system.

Regional Disaster Response Plan - A written document which outlines the resources available within a region and the role of each organization in responding to a disaster within that region.

EMS ORGANIZATION AND MANAGEMENT

There should be a regional plan for emergency medical services addressing at a minimum all of the components identified in this guideline.

The EMS council should establish appropriate subcommittees which meet on a regular basis to address EMS communications issues.

EMS council staff should provide administrative and clerical support of the subcommittee which carries out the communications projects of the council.

There should be an annual work plan approved by the regional EMS council with specific communications objectives and tasks to be carried out during the year.

The regional council should encourage involvement of medical directors in regional communications planning.

There should be a written regional disaster plan, which includes and addresses EMS communications issues. The plan should be rehearsed and contingencies for foreseeable failures of all types, including communications, should be practiced.

REGIONAL ROLE AND RESPONSIBILITIES

Establish and operate a regional EMS council. Employ and supervise EMS council staff. Develop and maintain the regional EMS plan. Prepare grant applications and administer grant funds. Coordinate among EMS providers, counties, and other local and regional EMS related organizations.
PLANNING EMERGENCY MEDICAL COMMUNICATIONS

Provide a forum for the discussion of local EMS communications problems and a clearinghouse for information and ideas.

Develop and maintain on a regular basis, the communications portion of a regional disaster plan.

STATE ROLE AND RESPONSIBILITIES

Designate the regional boundaries for EMS systems. Designate the regional EMS organization within each region. Establish statewide guidelines for EMS system development. Provide funding with state and federal grant funds.

Provide technical assistance to the regional EMS council on EMS communications issues.

Provide liaison and coordination with other state agencies regarding EMS communications issues.

Provide technical assistance to local governments, when developing communications systems.

HUMAN RESOURCES AND TRAINING

Dispatchers and other communications personnel must be trained to handle requests for emergency medical assistance, dispatch appropriate field units, coordinate EMS activities with other public safety agencies, and, under medical direction, provide emergency medical instructions to persons calling for medical assistance. Training programs should include continuing education, periodically conducted and readily available.

All persons using the communications system must be trained in the purpose, correct use and care of the equipment.

The general public should be informed about the EMS system including how and when to request assistance.

Local government officials should be educated as to the elements which make an effective EMS communications system and the value of such a service to their communities.

REGIONAL ROLE AND RESPONSIBILITIES

Assist in identifying EMS communications training needs for all levels of EMS personnel.

NATIONAL ASSOCIATION OF STATE EMS DIRECTORS
PLANNING EMERGENCY MEDICAL COMMUNICATIONS

Promote, and coordinate training programs for emergency medical dispatchers, field and hospital personnel, in cooperation with established training agencies.

Establish continuing education and specialized EMS training programs.

Assist EMS agencies, local governments, and teaching institutions in establishing, coordinating, and conducting communications training programs.

STATE ROLE AND RESPONSIBILITIES

Establish standards and support regional communications training efforts.

EMS FACILITIES AND MEDICAL DIRECTION

Hospital emergency facilities must be properly equipped and adequately staffed to ensure prompt and effective communications with other agencies and facilities.

A communications system to support medical direction of field EMS personnel should be established and operated.

Methods for contacting and recalling personnel during disasters or large scale emergencies must be established and in place.

Protocols which support the provision of emergency medical dispatch services should be developed, incorporated into training programs, and updated regularly in response to a quality assurance mechanism.

REGIONAL ROLE AND RESPONSIBILITIES

Encourage and involve physicians in EMS communications system development.

Develop, implement, and periodically review communications protocols.

STATE ROLE AND RESPONSIBILITIES

Provide technical assistance in the development of systems and protocols to support medical direction.

Promote physician involvement in the EMS communications system.

EMS TRANSPORTATION

Adequate communications coverage should be provided for EMS vehicles.

NATIONAL ASSOCIATION OF STATE EMS DIRECTORS
throughout their normal service area.

All public safety organizations should be fully integrated into the EMS communications system to facilitate effective coordination with EMS providers.

EMS vehicles should be provided with communications equipment and systems for the secondary transportation of patients, particularly the emergent transfer of patients to critical care centers.

REGIONAL ROLE AND RESPONSIBILITIES

Determine the need for EMS vehicle communications equipment.

Identify vehicle staging areas for emergencies and insure vehicles are equipped with common staging area communications channels.

Maintain training programs for communications procedures. Establish practiced discipline on communications channels.

STATE ROLE AND RESPONSIBILITIES

Establish vehicle communications equipment standards.

Provide technical assistance in site selection and development of wide area communications systems based on patient flow and transportation patterns.

Maintain resource lists including frequencies, telephone numbers, CTCSS tones, and selective calling information.
EMS SYSTEM EVALUATION

Each local EMS communications system should be periodically evaluated to
determine its efficiency and effectiveness in supporting the provision of emergency
medical care.

Call Reception, dispatch, and system utilization data should be captured, compiled,
and analyzed where possible to determine system capacity needs.

REGIONAL ROLE AND RESPONSIBILITIES

Develop an evaluation mechanism to identify regional communications needs and
resources.

STATE ROLE AND RESPONSIBILITIES

Provide technical assistance in the capture and analysis of data generated from
record keeping systems.

Evaluate each region utilizing the EMS systems evaluation format.

Analyze data provided by regions and generate composite reports of
communications system status.

EMS COMMUNICATIONS

EMS communications systems should meet the needs of the EMS system providers
and nationally accepted standards of functional performance.

EMS communications systems should be compatible with similar systems in
neighboring geographic areas.

EMS communications systems should be designed to minimize the chance for
interference with others.

EMS communications systems should make use of common resources where
appropriate and cost effective.

EMS requirements should be explicitly considered in plans for improvement of
citizen access and 9-1-1 telephone communications.

Each county should have one widely publicized emergency telephone number to be
used by the public to call for emergency medical assistance within the county.
Ideally, the number should be 9-1-1 and be answered in a coordinated central
Each county should establish a single agency that coordinates and dispatches all personnel, vehicles, equipment, and supplies necessary to respond in an efficient manner to medical emergencies within the county.

Each county should establish a single agency that coordinates the use of its emergency medical and allied emergency service resources with neighboring counties.

Citizens should not have to know their location in relation to any jurisdictional boundaries to determine the proper emergency telephone number to call.

There should be no financial barrier to requesting emergency medical assistance. Coins should not be required for calls from public telephones. All calls for EMS assistance should be free to the calling party.

Sufficient numbers of telephone lines should be provided into an EMS answering point to ensure that no more than one EMS call in 100 attempts ever receives a busy signal during the busiest hour of the day.

Sufficient answering "call taker" positions should be provided to ensure that at least 90% of EMS calls are answered within 10 seconds, or with no greater than three rings, during the "average" busy hour.

Call takers should be provided with written triage instructions or protocols for distinguishing EMS calls from other types of emergencies and should have adequate EMS training to utilize the protocols effectively.

EMS call transfer or information relay, if used, must be fast and reliable. "Call referral" or telling the caller to hang up and call a different telephone number must not be used for emergency calls.

EMS radio communications systems should meet state guidelines and conform to the state, regional and local EMS plans.

Incident command communications channels and procedures should exist. Information transfers and flow through the communications system on routine and disaster situations should be established to emergency operation centers and county communications centers.

Trunked and 800 Mhz communications systems should consider EMS requirements and meet state guidelines for compatibility and interoperability as well as conform to regional and local EMS plans.

The state EMS communications plan should be followed within each region and
local service area. All local plans must be coordinated with the state and should be compatible with contiguous states and geographic areas.

UHF systems should be centrally coordinated for assignment of radio channels and establishment of communications linkages.

System parameters including the number of simultaneously operational channels, the number of individual radio stations and their installation locations, should be selected to support multiple casualty incidents and lengthy communications that may be required.

EMS field personnel attending to a life-threatening or serious medical emergency should be given exclusive use of a radio channel for the duration of the medical incident.

EMS communications should extend to the actual patient treatment location.

Tactical frequencies for coordination of emergencies should exist and be widely coordinated to insure compatibility and to prevent interference to other communications.

EKG telemetry should be considered in an EMS communications system at the direction of the local medical community and ALS program medical director.

UHF MED radio systems which incorporate telemetry should allow for full-duplex operation to permit a physician directing an emergency incident to interrupt and control lengthy transmissions.

UHF EMS communications channel designations and assignments should conform to State standards and include provision for cooperation with all other users of the UHF MED spectrum.

EMS communications system design should ensure continued EMS communications during major disasters.

Methods for recalling emergency personnel during disaster situations should be established and account for various failure modes including loss of telephone systems, loss of electrical power, and loss of various radio facilities.

Staging areas should be identified and staging area communication channels established.

An EMS communications system in a local area should be organized in a manner that will guarantee each caller that the currently closest and most appropriate EMS response unit(s) will be assigned to their call.
An EMS resource coordination center should at all times monitor and be aware of the current location, status, and capability of all EMS response units in the geographic area including private and public ambulances, fire department EMS units, quick response teams, or other EMS resources.

An EMS resource coordination center should have the authority and ability to optimize the allocation of resources by preassigning specific units to particular locations in anticipation of need and relocating units as conditions change.

An EMS resource coordination center should have appropriate written policies and procedures for the assignment of specific predetermined combinations of units to particular types of EMS incidents.

The EMS dispatch sequence should be as direct as possible. Ideally, the person who answers a call for EMS assistance is also the radio dispatcher who makes direct contact with the units to be assigned to the incident.

If an EMS dispatcher must communicate with multiple units and locations for a given incident, the communications to all should occur simultaneously using common or similar means of communication.

Personnel with special EMS "dispatcher" training should provide guidance and direction via telecommunications to persons at the scene of a medical emergency pending arrival of trained EMS field personnel.

EMS should be coordinated with other public safety and public service emergency response units within the community through a central communications agency such as an emergency operation center.

All appropriate vital human physiological information necessary during any medical emergency should be transmitted from the site of the emergency to the proper monitoring and decision making emergency medical professionals.

All emergency medical vehicles should have the ability to communicate by two-way radio with the single EMS resource coordination agency within a county.

All county emergency telecommunications agencies should have the ability to intercommunicate by radio and other means.

All county emergency telecommunications agencies should have communications equipment operational on the state designated standard channels.

All hospitals that receive emergency patients and all emergency medical responding vehicles should have radio equipment that provides direct two-way radio voice communications between EMS vehicles and the hospital.
All hospitals should have communications ability appropriate to the level of medical direction required for the EMS program.

Regional communications plans should be written that define the purpose and scope of the EMS communications system. The regional and local operating procedures and protocols, including VHF, UHF and other communications channels should be explained and adhere to state and national guidelines.

All emergency response units should have a mobile radio that operates in accordance with the regional plan in a compatible mode on common channels.

Each responding emergency mobile unit that is equipped with a VHF radio should be able to communicate with any emergency hospital within its radio range regardless of the mobile unit location within the state.

Each emergency hospital should be able to communicate with any EMS mobile unit for which that hospital is the closest or most appropriate emergency hospital facility.

Each EMS mobile unit and hospital base station radio should be equipped with standardized common channels designated by the local and state EMS communications plan.

EMS VHF base stations should be designed to avoid nuisance interference caused by unintended or undesired radio communications through the use of continuous tone-controlled squelch systems (CTCSS) or other appropriate means.

If the need exists for an EMS VHF base station to incorporate selective calling, decoders which respond to DTMF or 1500 Hz interrupted code sequences should be used. Codes should be assigned by the state. The state should regularly publish a directory of these numbers for use by the EMS agencies.

All EMS radios should be clearly marked with standard identifiers for channels or "modes." Standard statewide terminology should be established and used for frequency identification.

Means should be identified, provided and routinely tested that enable law enforcement, fire, and EMS units from different agencies or areas to communicate with each other during disaster operations.

Independent stand-by power sources such as generators or batteries should be provided for fixed communications facilities to minimize the impact of commercial power outages.

Important facilities and locations should be served by more than one radio or radio site so that communication is not lost during disasters or wide-area emergencies. Communication systems should employ redundant geographic diversity of
equipment, such as multiple radio repeater sites, where feasible.

Sufficient telephone lines, radio channel capacity, and operating positions should be incorporated into systems to handle heavy communication traffic loads generated by wide-area emergencies or foreseeable disasters.

Disaster communications procedures should be well defined with emphasis on interagency coordination. Disaster procedures should be a straightforward expansion of the day-to-day procedures whenever possible, rather than a radical change in any operating procedure.

Disaster systems and procedures should be periodically exercised and tested in a realistic fashion. Tests should be reviewed and corrections made where failures have or may occur.

Communications operators should be formally trained in emergency medical services, telecommunications and radio communications techniques and skills.

EMS communications systems should meet technical standards applicable to all public safety communications systems.

EMS communications systems must meet all applicable Federal Communications Commission Rules and Regulations.

All emergency communications should be routinely recorded. The recordings should include date and time signals. Recordings should be preserved in accordance with the regional system plan requirements.

Where feasible, radio coverage reliability should be at least 90 percent (based on all locations within a service area) assuming inefficient portable antennas operating inside of prescribed buildings within the service area.

EMS communications equipment should be reliable and easy to operate.

Communications equipment should be tested daily and written procedures and logs maintained on problem reporting, repair and maintenance. All equipment should be periodically inspected and tested by competent technicians and repairs should be made promptly by trained and qualified personnel.

Radio coverage and service area boundaries should be defined and respected.

Measures should be taken to respect radio coverage requirements and to minimize interference outside the boundaries, including: use of directional antennas where feasible and appropriate; use of only minimum antenna elevation and radiated power necessary to cover the communications service area; and, use of continuous tone or digital-controlled squelch systems (CTCSS or CDCSS) where appropriate.
Strict adherence to "listen-before-talk" channel monitoring policies should be adopted by all communications users.

Frequency allocation and usage should be coordinated statewide and nationally when appropriate.

The state EMS communications plan should be used as the framework for coordination of EMS frequencies.

Selective signalling codes and tones should be coordinated and documented statewide.

EMS mobile units should include interoperability to enable every EMS mobile unit to travel anywhere in the state service area and remain in communications with EMS base stations.

EMS mobile units should adhere to a common statewide mobile frequency plan. All VHF units should be equipped with all standard channels. All UHF EMS units should be equipped with all MED-1 through MED-10 channels and standardized CTCSS tones with statewide standardized tone identification nomenclature.

EMS communications systems should be coordinated with law enforcement, fire, emergency management services, and other public safety radio systems in their area in terms of frequency usage, site engineering, and inter-system communications.

EMS communications system planners and users should be encouraged to share radio sites.

EMS communications system should share common system components such as microwave and telephone control lines where possible.

EMS communications systems should make effective use of state provided services and resources.

EMS system personnel should take an active role in influencing Federal Communications Commission laws and rule making decisions.

A statewide EMS communications planning organization should be implemented and maintained.

The state should maintain proficient EMS communications resources and assist local and regional communications personnel in the design and evaluation of systems, communications training, and communications implementation.
Regional EMS communications committees, that meet regularly, refine the regional communications plan, and resolve communications problems should exist in each region.

The following situations are incompatible with the objective of centrally coordinated EMS resources:

- multiple call-answering centers such that no single center can monitor the location of all current EMS incidents in the area;
- EMS response agencies competing with each other in soliciting or accepting emergency medical calls from within a common service area;
- multiple dispatch centers such that no single communications agency can monitor the current location and status of all EMS responders;
- ambulance agencies allocating their own units independently of each other, of fire or rescue units or other EMS services within the area;
- rigid geographic "franchise" schemes where units are assigned to incidents on the basis of nominal base or station location, rather than by current unit location and status.

REGIONAL ROLE AND RESPONSIBILITIES

Regional EMS communications plans should be developed in accordance with the state EMS communications guidelines.

Regions should assess and report on EMS communications needs within the area or region.

Regions should develop communications protocols and coordinate their use by local communications centers, including operational channel usage.

Regions should promote the establishment of enhanced 9-1-1 telephone systems to include EMS.

The region should establish and provide communications training programs for EMS field personnel, hospital personnel, EMS telecommunicators, and emergency medical dispatchers.

Regions should inventory existing EMS communications resources, equipment and facilities.

Regions should identify and plan for correction of deficiencies in regional EMS
There should be a regional EMS communications committee that meets regularly and routinely made up of knowledgeable individuals representing all EMS systems, users and agencies.

STATE ROLE AND RESPONSIBILITIES

Develop and update guidelines and plans for EMS communications in the state. Publish EMS technical data and manuals.

Designate EMS channels, coordinate EMS communications systems and determine conformance with state EMS communications plans.

Provide technical assistance to regions in developing EMS communications plans and assist in obtaining radio license eligibility for Emergency Medical Radio Service applications.

Provide technical and engineering assistance in developing EMS communications systems.

Establish, maintain, and fund shared area-wide radio systems.

Assist in development of specifications for communications system and equipment procurement.

Coordinate EMS communications with contiguous states or nations where appropriate.

Represent the state to federal agencies and programs.
1  WRITING THE REGIONAL EMS PLAN INTRODUCTION

Chapter one of the regional plan should be titled *INTRODUCTION*. The chapter should identify the developing agency, describe the background leading up to the plan development, indicate the general goal(s) of the plan, and provide an executive summary overview.

The agency responsible for preparation and submittal of the plan should be identified by name and address. In addition, the name and telephone number of a specific contact individual should be provided. The plan should also be dated.

The background section should provide a brief historical perspective on the previous development of EMS communications in the planning area.

The goal statement should be very brief and general. For example, the goal statement might indicate if the plan is intended to support an equipment procurement for a new system, or upgrade an existing system, establish advanced life support (ALS) communications capability, etc.

The executive summary should provide a brief overview of the remainder of the plan. The summary can be organized on a chapter-by-chapter basis, with a brief (few sentences) discussion of the highlights of each chapter.
CHECKLIST

INTRODUCTION

_____ 1.1 Has the responsible agency been identified?
_____ 1.2 Has the background to the plan been described?
_____ 1.3 Is there a general statement of the goals for the plan?
_____ 1.4 Is an executive summary provided?
2 DEFINING THE REGIONAL ORGANIZATION

CHAPTER TWO of the regional plan should be titled ORGANIZATION. The purpose of the chapter is to describe the organizational structure and source of authority of the agency submitting the plan, to identify other organizations involved in the plan, and to provide assurance that all of the key parties are in substantial agreement on the plan.

The internal organizational structure of the submitting agency, as it pertains to EMS communications, should be described by organization chart(s) and explanatory text. The description should cover line and staff functions and show the position of the specific official with overall responsibility for the plan.

The placement of the submitting agency in relation to important external organizations also should be explained, including such factors as the relationship of EMS communications to the overall EMS organization in the planning area; the relationship of EMS communications to other public safety communications functions in the area; the relationship of EMS to the overall local government organization structure; and the interface between the agency and the State EMS Division, Office or Agency.

The basis for the authority of the submitting agency to prepare and submit the plan should be described by specific references to the applicable laws, ordinances, statutes, interagency agreements, or memoranda of appointment.

External organizations having an important but indirect bearing on the plan should be identified and their relationship to the plan explained. These types of organizations might include communications providers and centers, health care providers, rescue and EMS provider units, and various local medical and professional associations, organizations, and hospitals.

The creation of a communications planning committee with representatives from the governmental unit responsible (such as the county manager's office), each of the EMS provider organizations, the hospital (administration), the physician and medical directors, the communications center or dispatch organization, and appropriate other public safety agencies should be considered. Concurrence of all key participants in the plan should be explicitly documented. This might take the form of a signature sheet with the authenticating signature of the responsible official of the submitting agency and sign-offs from representatives of all other participating agencies.
CHECKLIST

ORGANIZATION

_____ 2.1 Has the internal EMS planning/coordinating organization structure been defined?

_____ 2.2 Has its relationship to the external organization structure been explained?

_____ 2.3 Is the source of authority of the submitting agency identified?

_____ 2.4 Have other related organizations been identified?

_____ 2.5 Has authentication and concurrence been provided?
3 CURRENT EMS COMMUNICATIONS STATUS

CHAPTER THREE of the regional plan should be titled CURRENT STATUS. The purpose of this chapter is to define the EMS communications planning area and to provide an inventory of current communications resources including personnel, facilities, equipment, point-to-point communications links, and technical files.

The regional planning area will normally correspond to an EMS region, an EMS district, a county, or a group of counties. In some special cases, planning region boundaries which subdivide counties may be appropriate. In any case, the planning area boundaries should be shown on a map. The map, together with supporting explanatory text and tables, should also indicate the general distribution of population and such area characteristics as roadways, natural and manmade terrain features, EMS facilities, health care flow patterns, and climatic factors.

The personnel inventory should identify the numbers of persons associated with EMS communications by function, level of training, and location. Personnel costs also should be documented.

All facilities currently or potentially involved in EMS communications should be identified by function, location, ownership and management. Operational information and cost data should be collected and documented where relevant. Facilities of interest would include telephone answering centers, public safety radio dispatch centers, EMS communications coordination centers, ambulance and fire stations, hospital emergency departments, and radio sites. Particular attention should be given to identifying radio sites owned by the state, by police or fire departments and other local government agencies, or by public utilities or other users. The terms or conditions governing the possible shared use of these facilities for EMS communications also should be determined and documented.

EMS equipment currently in use should be inventoried in terms of make and model, type and age, function, location, user, cost, frequencies in use, and maintenance and repair support. The information should be summarized in tabular form.

It is particularly important that, for each radio site, all of the transmit and receive frequencies in use at that site be determined and documented, including those not related to EMS. The availability of backup power, equipment rack space, and tower mounting spaces for antennas are also significant factors. Radio license call signs, geographic information such as maps and plot diagrams, longitude, latitude, and ground elevation information should be included when available.

It is often helpful to document the entire EMS system frequency use on a table. The rows
of the table correspond to transmitters, receivers, control points, and mobile unit categories, while the columns in the table correspond to frequencies. The table then shows, in convenient fashion, all frequencies used by any particular equipment item and all locations and equipment utilizing any particular frequency. Control tones and sub-audible squelch tones also can be conveniently documented in similar tables.

Point-to-point communications links consist primarily of leased telephone lines and microwave channels. These should be identified and documented by type, function, location, user and cost. The cost of telephone lines is currently increasing at a significant rate, so that factor should be carefully investigated and then closely monitored over the life of the system. If State or local microwave facilities exist in the planning area, they should be considered for possible shared EMS use. The factors of interest include availability of channels and multiplex modems, location of microwave "drops" in relation to EMS facilities, reliability, and terms and conditions for shared use.

Files of technical information should be identified and reviewed and pertinent information extracted and summarized. Information of interest, in addition to all of the inventory data previously discussed, would include statistics on communications system activity, growth and performance (call volumes, response times, "no-load" ratios, channel loading, telephone line utilization, etc.).
CHECKLIST

CURRENT STATUS

_____ 3.1  Is the EMS communications planning area defined and a map provided?

_____ 3.2  Is a personnel inventory included?

_____ 3.3  Is a facilities inventory provided?

_____ 3.4  Is an equipment inventory provided?

_____ 3.5  Has a site characteristics inventory been developed for each site?

_____ 3.6  Has a frequency usage table been prepared?

_____ 3.7  Is a point-to-point link inventory included?

_____ 3.8  Is a technical file/statistical data summary included?
4 DEFINING REGIONAL GOALS AND OBJECTIVES

CHAPTER FOUR of the regional plan should be titled GOALS AND OBJECTIVES. The purpose of the chapter is to define the goals and objectives of the plan and of the EMS communications system. This chapter should provide a concise listing of all of the goals and the specific objectives related to each goal.

Goals and objectives should be clearly distinguished from each other and from their related implementing programs.

A goal is a statement of broad direction, general purpose, or intent. A goal is general and timeless and is not concerned with a specific achievement within a given time period. A goal statement should remain valid for the life of the plan. An example of a goal statement might be: "Ensure that the EMS communications system is compatible with other public safety communications systems in the planning area."

An objective is a statement of desired accomplishment that can be measured within a specific timeframe and under determinable conditions. The attainment of an objective moves the system toward a directly related goal. Objectives should be reviewed and updated during the life of the plan.

In contrast to goals and objectives, which describe what is to be accomplished, an implementing program is a plan for how to accomplish something. Thus the statement, "Install the sheriff's frequency in all ambulance radios" is neither a goal nor an objective, but rather part of a proposed implementing program or process for meeting the objective described. Other alternative programs for meeting the same objective might include development of a special joint operations channel, or installation of cross-channel patch in a dispatch center, etc. Implementation program and process statements should not be confused with goals and objectives, and should not be included in this chapter. Instead, goals and objectives should be defined independently of programmatic considerations and program plans should then be developed later in the course of evaluating alternatives.

Volume One of Planning Emergency Medical Communications includes a discussion of goals and objectives at the State level and provides a starting point for the corresponding portion of the regional plan. The regional goals and objectives, however, should be more specific and closely related to the particular conditions of the planning area.

The following are some suggested areas for consideration in the development of goals and objectives:

PERFORMANCE OF THE EMS COMMUNICATIONS SYSTEM
Citizen access communications, particularly the coordination of EMS requirements with 9-1-1 system development plans

Centralized control and coordination of EMS resources

Directness and efficiency of EMS dispatch communications

Basic life support communications

Advanced life support communications, and conformance to "common system" guidelines

Inter-hospital emergency communications

Quantities and distribution of equipment

Reliability and maintainability

Geographic coverage of the various radio systems

Telecommunicator EMD Dispatcher training and certification

Coordination of coverage boundaries

Coordination of frequency utilization

Coordination of CTCSS tone utilization

Communications links to hospitals outside the planning area

Conformance of mobile unit parameters with statewide standards

Frequency coordination

Site engineering standards to minimize interference

Inter-system compatibility for multi-agency operations

USE OF COMMON RESOURCES
PLANNING EMERGENCY MEDICAL COMMUNICATIONS

- Sharing of radio sites
- Use of state microwave or telephone systems
- Use of state services (purchasing, etc.)

AWARENESS OF THE EXTERNAL ENVIRONMENT

- Monitoring developments at the State and Federal levels
- Monitoring advances in EMS communications technology
- Contribution to formulation of State and Federal policies and programs

PROGRAM MANAGEMENT

- Establishment of an ongoing planning mechanism
- Establishment of a suitable system management organizational structure
- Personnel policies, training and recruiting
- Program direction by means of ordinances, agreements, policies, etc.
- Establishment of information feedback, evaluation, and control mechanisms
GOALS AND OBJECTIVES

Have the following areas been defined?

_____ 4.1  Functional performance of the EMS communications system
_____ 4.2  Interface to other EMS systems
_____ 4.3  Interface to other types of systems
_____ 4.4  Use of common or state resources
_____ 4.5  Awareness of the external environment
_____ 4.6  Program management
5 ANALYZING REGIONAL REQUIREMENTS

CHAPTER FIVE of the regional plan should be titled NEEDS ANALYSIS. The purpose of the chapter is to determine the general requirements for, and characteristics of a new system. Also included would be changes and improvements to an existing system, necessary to meet the previously defined system goals and objectives.

Requirements are the differences between what currently exists and the desired ideal conditions. A good approach to the analysis of requirements, therefore, is to go through the goals and objectives defined in Chapter Five, comparing them point-by-point with the current actual conditions as determined in the current deficiencies and opportunities for improvement and would help point out areas where further investigation is needed before system design can begin. Existing plans and requirements studies should be reviewed as a starting point for this task.

The following are examples of the types of questions to be considered in the requirement analysis:

- Which system type? Basic Life Support (BLS) or Advanced Life Support (ALS)?
  The answer can affect the makeup and cost of the communications system. In addition, it affects the operation of the system and the cost of support equipment.

- Which frequency band? VHF, UHF, 800 MHz?
  The frequency band decision is made by considering the neighboring systems, inter-system compatibilities, system requirements and configuration, radio traffic, interference, terrain, budget and frequency availability. 800 MHz systems will require participation by the entire governmental units, as few EMS systems can support the unit loading requirements established by the FCC.

- What are the neighboring systems?
  If all the adjoining systems are VHF, then installation of a UHF system will limit mutual aid communication capability unless some form of VHF system is also in place. A similar situation exists with 800 MHz systems and between trunked radio systems.
How much radio traffic is expected?

The amount of local radio traffic and the amount of radio traffic of adjoining systems which could cause interference will determine the number of channels required.

Where is radio coverage desired?

Of course, it is desirable to provide radio coverage everywhere. Unfortunately, that would be prohibitively expensive. Therefore, areas which have a higher likelihood of regular calls (along major highways, industrial plants, and population centers) and potential disaster areas (chemical dumps, mines, and mountain resorts) should be considered first for radio coverage. These areas should be identified and prioritized in order to achieve maximum cost-effectiveness.

Who is going to do the dispatching?

Ideally, one communications center should dispatch for a large area so resources can be coordinated. This also reduces the amount of equipment required. The determination of a dispatch center location is often a political decision more than a technical decision. If more than one dispatch center is going to be used, each center should have clearly defined boundaries.

Is biomedical telemetry required?

There is debate over the inclusion of EKG telemetry. This question should be considered carefully with several factors taken into consideration, including:

- Requirements from the Medical Director
- The level of field responder EMT capability
- State laws and rules
- Effectiveness of telemetry
- The system cost and complexity

In addition, FCC rules permit the use of telemetry on the VHF band as well as the UHF band, however, there is an annoying tone transmitted when EKG is sent that must be monitored by others on the frequency. Some systems utilize cellular telephone systems for telemetry requirements. This should also be evaluated during system design.

Which medical facilities are to receive communications?

Generally, all hospitals in the area should participate in a BLS communications system. In rural areas, a doctor's office or medical clinic may also need to be included, especially if the hospital is a significant
distance away. In an ALS system one hospital should be designated as the medical direction or medical direction hospital.

How much money is available?

This question often gets overlooked until after the system is designed. Then pieces of the design are removed to lower the cost. Usually, this results in an unsatisfactory design. The system should be designed with at least general budget constraints in mind. This way the groundwork can be laid for future system expansion as more funds become available.
CHECKLIST

NEEDS ANALYSIS

_____ 5.1 Have existing plans and requirements studies been reviewed?

5.2 Have the following functional requirements been defined?

_____ Citizen access/9-1-1 requirements

_____ Centralized control and coordination requirements

_____ EMS dispatch requirements

_____ BLS communications

_____ ALS communications

_____ Inter-hospital communications

_____ Quantities and distribution of equipment

_____ Reliability and maintainability

5.3 Has the interface to other EMS systems been defined?

_____ Coordination of coverage boundaries

_____ Coordination of frequency utilization

_____ Coordination of CTCSS tone utilization

_____ Communications links to outside hospitals

_____ Compatibility of mobile unit parameters

5.4 Has the interface to other types of systems been defined?

_____ Frequency coordination

_____ Site engineering

_____ Inter-system compatibility for joint operations
5.5 Has the use of State and shared resources been considered?
   _____ Use of state radio site(s)?
   _____ Use state microwave system?
   _____ Use state telephone system
   _____ Use state services

5.6 Have the following program management areas been defined?
   _____ Ongoing planning mechanism
   _____ Suitable organizational structure
   _____ Personnel policies
   _____ Recruiting program
   _____ Training programs
   _____ Ordinances and rules
   _____ Information systems
   _____ Evaluation procedures
6 EVALUATING REGIONAL ALTERNATIVES

CHAPTER SIX of the regional plan should be titled *EVALUATION OF ALTERNATIVES*. The chapter should identify the system concept selected through consideration of alternatives. All sources of potential systems which have been considered or which are in use should be indicated. Subsystem alternative evaluations and appropriate reviews of literature and research material should also be considered. When innovative techniques are considered, their impact on system performance and cost should be taken into account.

Alternatives should be evaluated in terms of technical, functional, and operational feasibility. Each alternative also should be evaluated based upon Federal, State and local statutes, planning in neighboring states, the provisions of the FCC rules, and consideration of the communications capabilities and plans of other providers of emergency services.

Selection of the optimum concept or alternative should be made using an explicit evaluation technique. This technique considers each alternative in terms which measure how well the EMS requirements are met. Each concept should be priced for comparison. This cost should be the total implementation and operating cost projected over a specific operating period (i.e., one to five years).

The following are some basic system design considerations and some specific design models which might be considered in the evaluation of alternatives.

SYSTEMS DESIGN CONSIDERATIONS

All EMS communications systems are comprised of three basic types of components: a base station, a control console, and a mobile unit. There are also a number of options which are generally recommended as part of basic systems designs in order to enhance operational capability and ease of use. These are described first to facilitate the explanations of basic equipment configurations which follow.

Various options and additions are available, including multiple base stations, mobile relay stations, vehicle repeater stations, telephone interconnect, medical telemetry, mobile data, automatic location, pager and monitor receivers, and logging recorders. In this section, the basic building blocks of a radio communications system will be described. Site selection, coordination, and site engineering will be discussed. These topics will be discussed in general terms only and specific system designs may require additional information. The intent is to give the EMS planner the background to discuss requirements with the technical advisors and determine the basic design and system operational characteristics.
Continuous Tone Controlled Squelch System (CTCSS) -- CTCSS is used to eliminate nuisance audio coming from other radio systems using the same radio frequency. This feature is a subaudible (not audible or heard) tone that is sent by a transmitter that causes that transmitter's audio to be heard from the receiver--s speaker. While other transmitter signals on the frequency may be received by the base station receiver, only those transmitters sending the proper CTCSS tone will be heard from the receiver's speaker. This reduces the amount of nuisance conversations heard at the base station control console.

 Rotary-Dial Decoder (Pulse Decoder) -- This feature allows a mobile with a rotary-dial encoder to override or bypass the CTCSS decoder. In this way a mobile unit lacking the appropriate CTCSS tone can contact a hospital (e.g., a mobile from another geographic area or system) by dialing, or encoding the appropriate number. With older radio systems, the mobile unit actually had a dial, similar to that used on dial telephones. Current equipment has push buttons and circuitry to create the interrupted tone. Hospitals are assigned different series of numbers, analogous to telephone numbers. If the mobile radio is within range, a specific hospital can be called. If hospitals are equipped with a rotary-dial encoders, they can call other hospitals within radio range. This feature is used mainly on VHF systems and is of older technology. Newer systems and UHF systems should consider using dual-tone multifrequency (DTMF), which is discussed below. Rotary-dial or pulse-code systems should only be considered when required for compatibility with older stations or systems.

 Dual-Tone Multifrequency "touchtone" Decoder -- This system is similar in function to that of the Rotary-Dial decoder system discussed above. It is the method of choice on UHF and other newer systems. Instead of rotary-dial, a push-button pad is used to generate simultaneous tones like those heard on a "touchtone" telephone.

 Tone Squelch Disable (Emergency Override) -- This feature allows a person at the radio control or console to turn off the tone decoders so that all communications can be heard on a frequency. This is often used during disasters or wide-area emergencies so that mobile units do not have to "dial" or "encode" to the hospital. This is important if mobile units without the correct CTCSS tone (i.e., those from another area or region) are responding to a disaster and capability for communications are desired.

 Automatic Battery Reverting -- This feature allows a base station or console to operate on battery power during a power failure. A battery charger is usually included as part of equipment, but this should be verified before the equipment is purchased.
Time-Out-Timer (TOT) -- This feature is a timer that will disable the transmitter after a preset amount of continuous transmit time, usually three to five minutes. This keeps a keyed transmitter "stuck-mike" from disabling the entire system.

Tone Remote Control -- This term refers to a method a radio console or desk-top radio control uses to operate a base station. "Tone remote control" uses different frequency tones or tone durations (specific bursts) of audio to operate and control the base stations from the control console. Tone control equipment permits flexibility in the choice of telephone circuits to the base station. In addition, tone control can more easily be used over microwave or other radio links. All new equipment should utilize tone control. In some instances the use of digital control or computer signaling should be considered.

Basic equipment configurations used for EMS communications are discussed below. Block diagrams, options, and application information are given for some of the configurations discussed.

TWO-CHANNEL VHF BASE STATION

The two-channel base station is a basic building block for a VHF system. The two frequencies used will depend on the location. 155.340 MHz, 155.280 MHz and 155.400 MHz are commonly used. There are two basic configurations of this station. One uses a single receiver and the other two receivers. Figure 2 is a block diagram of a single receiver base station. These stations were frequently provided as two-receiver base stations to permit monitoring of two frequencies simultaneously. The stations are sometimes called "HEAR" stations for "Hospital Emergency Administrative Radio" or "EACOM" for "Emergency Administrative Communications." The radio stations are no longer manufactured under these trade names, however, many EMS systems still use the frequencies and concepts of the two-frequency system.
The single-receiver base station uses the same receiver to receive both frequencies. This is done by switching the receive frequency from the control console. When the base station is switched to one frequency, calls placed by the mobile units on the other frequency will not be heard. This limitation can often cause operational problems in real-world situations. Unless operators are well trained and versed in operation of multiple frequency stations, this system configuration should be avoided.

The two-receiver base station uses two receivers, one on each frequency. These allow the mobile unit to call on either frequency which may be advantageous in areas where the mobile may be receiving interfering signals from another system and needs to switch frequencies to avoid the interference. Some systems use the two different frequencies for different purposes, such as a common state-wide frequency and a local frequency. Problems are experienced in actual practice, however, as the hospital personnel may not be able to determine which of the two frequencies they were called on and therefore may answer on the wrong frequency. This must be overcome by the field unit making an announcement about which of the two frequencies they are calling on during the initial contact, or by inclusion of "channel use" indicator lights at the hospital console. The corresponding transmitter frequency is then selected by the operator at the hospital or control console, regardless of the number of receivers. The operator can only talk to one mobile at a time; therefore, two transmitters are not needed.
The two-receiver base station is generally preferred because of its operational flexibility. The base station should have the following as a minimum:

- All solid-state design
- Dial decoder (one for each receiver)
- Automatic battery reverting or emergency power
- Time-out-timer
- Tone remote control
- CTCSS squelch disable
- CTCSS operation on only one receiver

**TELEPHONE INTERCONNECTED BASE STATION**

The telephone interconnected base station is operated in a manner similar to a mobile telephone. The primary application of this concept is in rural areas where dedicated leased lines to the base station would be very expensive and where a mobile unit might want to call a doctor at home after hours. There are several significant limitations to this system, the primary one being the lack of positive transmitter control by the telephone user. This means a voice-operated transmit switch, sometimes called a "VOX" or some other means must be used to switch from transmit to receive. As a result, the operation of these systems is more complex than a regular radio system. In rural areas, however, they can provide a cost-effective solution to providing radio coverage.

The mobile unit communicates with the base station by radio. The base station is connected to a dial-up telephone line and the mobile unit operator then "calls" the hospital (or "doctor at home") much as would be done with a standard telephone.

The equipment generally available does not readily lend itself to two-channel base station operation. This is due to the lack of direct control by the telephone end party which has only a standard telephone. While this type of control could be provided by other equipment, the integration of the various components becomes quite complex and is beyond the scope of this discussion. Other alternatives such as scanning receivers and dual receivers often cause more operational problems than they solve and should be used only in a few selected applications. Therefore, a single-frequency base station is generally recommended.

Figure 3 is a block diagram of a typical telephone-interconnected base station. The telephone-line interface equipment may be provided by a supplier other than the radio equipment vendor. This type of operation is sometimes referred to as "auto-patch" operation.

The telephone interconnect system should have as a minimum the following:
BASE STATION CONTROLLED BY RF OR MICROWAVE LINK

Many times, mountain top radio sites do not have leased control or telephone lines available to them, or the lines are unreliable due to ice or other conditions. As a result, some other method must be provided for controlling the base station. One method is a radio "link" or control station operating on VHF or UHF frequencies. This is used to send and receive audio and control signals between the remote base station site and the control console. This method of control has a disadvantage, however, as two additional base stations (for the radio links) must be purchased. This raises the cost of system, however, it can eliminate the recurring costs associated with dedicated leased lines. Additionally, a burden is placed on the radio spectrum by the requirement for additional radio frequencies to be used for the link. These frequencies are often not available, or are available only on a "secondary use" basis. This exposes the control link to potential interference. The initial cost for the additional required control equipment must be compared with the ongoing dedicated leased line charges. Long term costs are usually decreased and long term reliability is increased when mountain top base stations are controlled by radio frequency (RF link).

Microwave links should be considered when more than two audio or control circuits are
required at a specific site. Microwave systems operating in the 1.8 GHz to 2.3 GHz portion of the spectrum should not be considered, however, due to the reallocation of this frequency band away from public safety use. All of these factors must be considered when making system design decisions.

VHF AMBULANCE INSTALLATION

An ambulance installation consists of three major components: the radio, the control head, and the antenna. If a telephone-interconnected base station is used, a DTMF encoder is also required. The antenna can be either a unity-gain quarter-wave type or a 3 dB gain type.

Figure 4 is a block diagram of a typical ambulance system. As a general rule, the unit should have the following:

- All solid-state design
- Multiple CTCSS operation
- Priority-scanning receiver operation
- Time-out-timer
- Burst-tone encoder (1500 Hz or DTMF)
- Multiple frequency operation
- Control head in driver compartment
- Control head in patient compartment

![Figure 4  VHF Mobile Unit](image-url)
MULTI-CHANNEL UHF BASE STATION

UHF system configurations are different than VHF systems. Dispatch and administrative frequencies are available as well as frequencies for medical direction and control. Systems designers may want to start with one single-channel base station for dispatching and one four-channel base station for emergency medical direction operations. As radio traffic increases, additional base stations may be installed.

The UHF base stations should have the following:

- All solid-state design
- Full-duplex operation (optional)
- CTCSS operation
- 100 percent transmit duty cycle
- Squelch disable (emergency receive)
- Battery backup and emergency power
- Mobile relay capability (optional)

Mobile relay operation is strongly recommended as it permits mobile units to hear each others transmissions. UHF mobile units transmit and receive on different frequencies. Without mobile relay (base station repeaters) the mobile units will not hear each other and therefore have a tendency to "transmit over" or "walk on" each others transmissions. Rebroadcasting or "repeater" base stations allow the mobile units to hear and communicate with each other.

MULTI-CHANNEL UHF MOBILE RELAY (REPEATER) BASE STATION

A mobile relay station is used to improve radio coverage and to enable communication between mobile radio units. The repeater is usually located on a mountain top or other geographically advantageous location and frequently may not have dedicated control or "leased lines" connecting it to the hospital. The mobile relay "repeats" signals received on the input receiver frequency by transmitting the signal on the output frequency. Therefore, all the mobile units and the hospitals "listen" on the repeater output frequency and transmit on the repeater input frequency. Normally, the higher frequency of a UHF repeater "frequency pair," the 468 MHz frequency, is the base station or mobile relay receiver frequency. The lower, 463 MHz frequency, is the base station transmit frequency. In some mobile relay systems which utilize vehicle repeaters and duplexed mobile units or portable units, the second repeater receiver and control frequency for the hospital or communications center is recommended. The control center (CMED) or hospital transmits audio and control signals on this third frequency which is given priority over the other receive frequency. The number of available control frequencies is limited, especially in urban areas and the system planner should check for control frequency availability before progressing too far with this approach.
Mobile relay systems should have the following:

- All solid-state design
- 100 percent transmit duty cycle rating
- Two receivers (one primary and one for control)
- CTCSS operation
- Tone remote control (optional)
- Full-duplex operation
- Command receiver audio override
- Battery backup and emergency power
- Time-out timer
- Automatic station identification

The mobile relay system design must also employ a radio transmitter and receiver station which is used to operate or "control" the mobile relay. This is sometimes referred to as a "control station" and is classified by the FCC as a "FX" or fixed station.

UHF AMBULANCE CONFIGURATION

A UHF ambulance installation is similar to that of the VHF ambulance installation except that the auxiliary control head for the patient compartment of the ambulance is more important because of the close doctor-EMT communications normally associated with UHF EMS systems. If EKG telemetry is incorporated, the capability of talking while sending telemetry, referred to as *multiplexing*, is sometimes desired and requires additional equipment in the mobile. Vehicular configurations are discussed in the next section.

Figure 6 is a block diagram of a UHF ambulance unit. As a minimum the equipment should have the following:

---

**Figure 5 UHF Multi-Channel Base Station/Mobile Relay**

Mobile relay systems should have the following:

- All solid-state design
- 100 percent transmit duty cycle rating
- Two receivers (one primary and one for control)
- CTCSS operation
- Tone remote control (optional)
- Full-duplex operation
- Command receiver audio override
- Battery backup and emergency power
- Time-out timer
- Automatic station identification

The mobile relay system design must also employ a radio transmitter and receiver station which is used to operate or "control" the mobile relay. This is sometimes referred to as a "control station" and is classified by the FCC as a "FX" or fixed station.

UHF AMBULANCE CONFIGURATION

A UHF ambulance installation is similar to that of the VHF ambulance installation except that the auxiliary control head for the patient compartment of the ambulance is more important because of the close doctor-EMT communications normally associated with UHF EMS systems. If EKG telemetry is incorporated, the capability of talking while sending telemetry, referred to as *multiplexing*, is sometimes desired and requires additional equipment in the mobile. Vehicular configurations are discussed in the next section.

Figure 6 is a block diagram of a UHF ambulance unit. As a minimum the equipment should have the following:

---

**NATIONAL ASSOCIATION OF STATE EMS DIRECTORS**
All solid-state design
CTCSS operation
Time-out timer (unless full duplex operation used)
All MED channels operational
Second control head for patient compartment
Adaptable for telemetry

Note: Be cautious of incorporating time-out timers in systems with vehicle-mounted repeaters which also include telemetry. The portable unit may "time-out" the vehicle-mounted repeater. When this has happened it was necessary to go to the vehicle location and re-cycle the mobile unit to get it to function again.

Figure 6  UHF Mobile Unit

UHF VEHICULAR REPEATER

A vehicular repeater is similar in function to the fixed location mobile relay station, except with the vehicular repeater the radio repeater equipment is mounted in a vehicle (ambulance). There are several distinctive configurations of vehicle mounted relay equipment, or vehicle repeaters, as they are sometimes called. The various configurations

NATIONAL ASSOCIATION OF STATE EMS DIRECTORS
ONE-WAY VEHICLE REPEATERS

These systems relay the signal from a low-power portable unit when the EMTs are away from their vehicle through the more powerful transmitter of the mobile unit. This happens in the portable-to-base-station direction only. When the portable receives, the signal is from the base station directly. This vehicle relay configuration is sometimes referred to as a "three frequency talk-around" system because it uses three frequencies (one from the portable to the vehicle, a second for vehicle to hospital or base station, and a third frequency for hospital to portable transmission) and the signal from the base station "talks around" the vehicle.

TWO-WAY VEHICLE REPEATERS

Two-way vehicle repeaters repeat signals in two directions. This is accomplished either on a cross-band (VHF to UHF) basis, or on an in-band basis using only UHF frequencies.

Cross-band repeating incorporates a mobile radio designed with an additional, second transmitter and receiver. In essence two mobile units are connected so signals received on the VHF receiver are retransmitted on the UHF mobile transmitter, while signals received on the UHF receiver are crossed and retransmitted on the VHF receiver. This is a very effective method of achieving good patient-side (away from vehicle) coverage in geographic regions where base station coverage is not practical all the way to the portable.

A second method of two-way vehicle repeater operation uses two UHF receivers and a single UHF transmitter. This is sometimes referred to as "in-band repeating." The transmitted signal from a portable radio, customarily on a frequency in the 458 MHz range, is received by the first UHF receiver on the vehicle. The audio signal is routed and connected to the UHF transmitter, the transmitter is keyed and the audio signal is retransmitted on the mobile transmit frequency, usually in the 468 MHz range. The signal is then received by the base station. When the base station transmits, usually on a frequency in the 463 MHz range, it is received by the second UHF receiver in the vehicle. The received audio is "mixed" with the audio from the first receiver and transmitted on the 468 frequency to the portable radio at the patient side. Figure 7 is a block diagram of a UHF Vehicle Repeater.
This type of vehicle repeater operation sometimes incorporates a portable radio which operates "full duplex." In other system designs this is accomplished with a second portable radio carried to the patient location, rather than using duplexed radio equipment. Other systems have been reported to use small monitor "pager" type receivers for this purpose. The complex MED systems are becoming less common as radio manufacturers discontinue production of the "older style" MED radios.

The mobile unit is capable of operation on any of the ten MED frequencies. It is also equipped with a second receiver which can receive on any of four special frequencies for portable-to-mobile communications. The portable unit receives on any of the ten MED channels and transmits on any of the four special portable-to-mobile frequencies.
SITE SELECTION

The choice of the correct location for radio base station equipment is not as simple as just "placing it on the big hill outside of town" as is often done. The EMS communications system planner should consider the following when selecting a site:

Coverage area - once the area over which radio coverage is desired has been determined, the site or sites needed can be selected. It is important that the actual coverage from a radio site be known. This can only be done by field measurements. These can come from an actual coverage survey or by talking to other users of the site about their existing coverage. It should be remembered that EMS communications generally require a higher signal strength than do general business users because of the critical nature of the communications. In many areas, it may not be possible to cover the entire area adequately with only one site. The highest site may not be the best because of potential interference as discussed next.

After the required area for geographic coverage has been determined, it is necessary to define the quality of radio coverage within that area that is needed. This is usually expressed in terms of a percentage of locations that will be provided radio coverage for a percentage of the time. As a rule, the system should be designed on the basis of "TALK BACK FROM MOBILE UNIT" to the base stations from 90% of the locations in the desired coverage area 90% of the time. A theoretical propagational analysis (radio coverage study) should be performed using a computer coverage modeling system. The resulting radio coverage contours can be overlaid onto a map of the desired geographic coverage area to provide a visual indication of the potential radio coverage. The radio coverage study must clearly state the signal strength level within the coverage contour in microvolts per meter or dBu. Those providing the coverage prediction should also provide the details for the parameters under which the study was made.

Radio equipment vendors designing the system and providing system radio equipment should be required to demonstrate by "pre-agreed upon tests" that the system meets or exceeds system specifications and standards by actual field measurement.

Interference Potential - All EMS users share the same frequencies. This is an especially important consideration on the VHF band, where only two frequencies are used and the radio signal range is greater than UHF. The selected site(s) should not be located such that interference is received from or created for other systems. Many times very high mountain top sites actually provide less usable coverage because of the severe interference they receive. A method to determine the level of interference is to listen at the site on the proposed frequencies over a period of time. If possible, the users of the adjacent systems should be notified so test signals can be sent.
The importance of interference cannot be overstated, because it can render an otherwise good system useless.

Adequate Space for Antennas - Good radio sites are always in demand. As a result, these antenna support structures are often overloaded with antennas. Inadequate antenna spacing can cause interference and system degradation. The EMS planner may need to provide for an additional support structure.

The possibility of using existing towers should not be overlooked. In many instances towers constructed by other governmental entities or agencies may be available and adequate for use in an EMS system. When determining if an existing tower is suitable for EMS purposes the factors to consider should include, but not be limited to, the following:

Will the tower location provide the required coverage as determined by the propagation studies mentioned above?

Will the addition EMS equipment and frequencies cause any interference to existing tower users or to the EMS equipment to be added?

Will the tower be able to adequately handle the additional loading stress placed on it by the EMS antennas?

Will access to the tower by service personnel be restricted by weather conditions, road conditions, or access time constraints required by the tower owner?

Is the tower available at a reasonable cost through a long term lease agreement?

The possibility of locating, constructing, and developing an EMS tower site should be considered. It may be that this would be in the best interest of the EMS system in the long term. When determining whether to develop an EMS tower site, the factors to consider should include, but not be limited to, the following:

Are any existing tower sites adequate and available under reasonable terms?

Are long term costs reasonable and is funding immediately available?

Is EMS control of the site necessary or desirable?

Will the EMS system be expanding beyond the capabilities of any
Adequate Interior Space for Radio Equipment - Adequate space should be provided for the equipment to allow for ventilation and servicing. A minimum of three feet in front and back are recommended. Optionally, the equipment can be installed so it can be moved a short distance (two or three feet) for servicing without taking it out of service. The radio equipment should not be located in the same room as the auxiliary power plant or batteries or near heating ducts. Building space may be conserved by racking mounting radio equipment. Most newer equipment may be rack mounted without causing or being exposed to interference.

Availability of Commercial Power - In general, sites that do not have commercial AC power should be avoided unless there is no other choice.

Emergency Power Generator Capability - Emergency power generation is required in case the primary AC power fails. The generator should be capable of supporting the entire load, but should not be oversized by more than twenty percent of the power required at the site. Radio sites often contain more equipment than they were actually designed for and the generator is actually overloaded. Also, consider that the newer synthesized equipment includes computer style programmed memories, particularly with control functions. These can forget the programmed function unless battery backup is provided. This must be in addition to emergency generator power to account for the period between when electrical power is lost and the generator is starting.

Solar Power - Standby battery systems with solar-powered charging equipment are sometimes effective for remote sites with moderate power loads and low duty cycles. This option should be considered where appropriate.

Availability of Control Circuits - Remote transmitter and receiver control circuits can be telephone lines, microwave radio, or a VHF or UHF RF link. If telephone lines are not available at the site, then microwave or RF links will be needed. If there is a "radio line of sight" between the control point and the tower site then the probability of a microwave or UHF link working is good. If the site is extremely remote, then control may be difficult and expensive. See the earlier comments on microwave and RF control links.

General Security of the Site - The critical nature of medical communications makes reliable operation extremely important. A site subject to vandalism, theft, or other disruptions is not satisfactory. Other users of the site could be asked about the security and any incidents they might know about.

Accessibility of the site - Many radio sites, particularly on mountain tops, are
not accessible year round. Snow, ice and other seasonal conditions make some sites unsuitable. Mud on dirt roads will occasionally make access difficult in conventional two-wheel drive vehicles. If a site cannot be accessed, it will be difficult to install and maintain.

Each of the factors above need to be carefully considered and the site selected that best meets the needs of the factors.

SYSTEM COORDINATION

Since EMS systems share the same frequencies, cooperation between users in bordering areas is necessary if the systems are to function properly. In particular, the CTCSS tones, rotary dial codes and DTMF codes all need to be coordinated. In addition, in areas where the radio traffic is heavy, users should work out operating agreements to avoid needless interference to emergency communications. For example, one area might use 155.340 MHz as its primary channel and an adjacent area might select 155.400 MHz. The State EMS agency should maintain records of the systems and provide coordination of the frequencies, tones and codes used for the EMS communications systems.

Since the purpose of the CTCSS tones and the rotary or DTMF dial decoder is to provide selective calling, it is important that these be coordinated. The coordinating agency should be the State EMS office. EMS planners should request this information about their system and provide updated information to the State agency so all information is current. Bid specifications should require vendors to ensure that tones will be selected to avoid interference.

The EMS planner should determine the approximate service area boundaries of the neighboring systems. The boundary line locator should be that which best provides for medical needs of the patient. This may also mean a cooperative effort is required, especially in rural areas.
SITE ENGINEERING

Proper radio site engineering is important not only for proper system operation but also to reduce interference to other users. It is recommended that any radio equipment installed where there are other users be equipped with the following:

- An isolator
- A bandpass cavity
- A minimum number of antennas
- Directional antennas where possible

Figure 8 is a block diagram of a VHF base station showing where the bandpass cavity and isolator are located. The isolator blocks other signals coming in from the antenna (i.e., signals from nearby transmitters) to keep them from reaching the transmitter where they can cause interference. The bandpass cavity reduces the amount of extraneous signals and both received and transmitted by the base station. Some radio site owners require these two devices before a base station is allowed to operate on their sites. When specifying equipment, the EMS planner should be sure to include these items in the specifications.

A list of all of the frequencies (both transmit and receive) should be obtained and an intermodulation interference and other electro-magnetic interference (EMI) study should be conducted. Intermodulation interference is caused by combining two or more frequencies resulting in a third or near a receive frequency. Additionally, if any 200 KHz (.2 MHz) of special precautions reduce interference transmitter noise and desensitization) to the receiver. The EMS planner should consult with state EMS office or other technical source for help if necessary.

The use of a minimum number of antennas is important to save valuable tower space. Usually VHF systems only use one antenna.

Figure 8  Bandpass Cavity/Isolator Location
UHF systems sometimes use multiple base stations. Instead of using one antenna for each base station, the use of transmitter combiners and receiver multicouplers may be desirable. A transmitter combiner allows several transmitters to be combined into one antenna. A disadvantage is the additional cost and signal and power loss associated with these devices. A receiver multicoupler feeds several receivers from one antenna. These are relatively low cost and do not cause any significant loss of signal. Using a receiver multicoupler amplifier in conjunction with the receiver multicoupler helps offset the loss associated with a multicoupler and can improve system performance.

If the site is selected near the edge of the EMS service area, a directional antenna should be used. This will direct more of the signal towards the area desired. It will also reduce the amount of signal which spills over into the neighboring area or state. Frequency coordination and licensing may be easier if directional antennas are used to reduce power radiation toward or in certain areas. Coverage in the desired areas may also be improved by the proper selection and use of a directional antenna.
EVALUATION OF ALTERNATIVES

6.1 Have alternate system concepts been identified?

_____ Have subsystem alternatives been identified?

_____ Have approaches used by others having similar problems or objectives been considered?

_____ Have system users been consulted in identification of alternatives?

_____ Have communications systems in use or planned by public safety and other emergency service providers been considered?

_____ Has literature and reference material been searched in the development of alternatives?

_____ Is biomedical telemetry needed?

6.2 Have alternatives been considered in the following areas:

_____ Organization of radio networks, combined systems or multi-user systems?

_____ Interagency coordination?

_____ Channel use and availability of frequencies or channels?

_____ Citizen access, 9-1-1, call boxes, vehicle location systems, caller location identification and cellular telephone?

_____ Dispatching, computer-aided systems, paging, radio alerting, computer data transfer systems?

_____ Data systems, data collection and report generation?

_____ Radio system configuration?

_____ System facilities, site availability, shared use agreements?
6.3 Have alternate system concepts been identified and evaluated?

_____ Has the technical feasibility of each alternative concept been established?

_____ Does the system alternative require only currently available components?

_____ Are newly established system alternative identified and available?

_____ Are the performance requirements, such as radio range and coverage, reasonable and achievable?

_____ Have the frequencies required for each alternative identified and available?

_____ Are the available frequencies compatible with other frequencies in use?

_____ Have computer prediction models for possible interference between systems been conducted?

_____ Are all required facility modifications and/or equipment modifications identified and determined to be feasible?

_____ Can all EMS providers participate in the system (private ambulances, military hospitals/ambulances, volunteer rescue squads, adjacent city/county/region/state, etc.)?

_____ Is the impact of selective signaling considered in terms of compatibility, costs and system performance?

_____ Are channel assignments, selective signaling and procedures coordinated with adjacent systems and other systems which require cooperation, coverage or compatibility?

_____ Are the alternatives in compliance with city, county and state laws
and regulations such as tower ordinances and FAA requirements, building codes, etc.?

_____ Are the alternatives in compliance with FCC Rules and Regulations?

_____ Has required state approval been obtained for licensing, permits and approvals?

_____ If aircraft are involved, do the alternatives consider the military and civil air complex operations, flight following and medical communications?

_____ Have the alternatives been compared in consonance with national standards and goals where established?

_____ Do the alternatives meet the operational requirements within each participating agency?

_____ Do the alternatives meet interagency operational requirements?

_____ Are required point-to-point coordination communications provided?

_____ Are required mobile-to-mobile coordination communications provided?

_____ Are required "ringdown" and "intercom" or data lines provided?

6.4 Have the following factors been considered in the selection of the concept?

_____ Has the system effectiveness been established and explained?

_____ Does the system reduce radio channel congestion?

_____ Does the system reduce telephone or microwave overloads?

_____ Does the system improve response time?

_____ Does the system provide mutual aid and coordination capabilities?

_____ Does the system provide more efficient command and control capabilities?

_____ Does the system provide required radio coverage?
Does the system provide needed system reliability?

Have possible failure modes been analyzed?

Does the system provide rapid access to information systems?

Have the system cost factors been identified?

6.5 Have the following investments costs been identified:

Hardware, equipment and construction costs?

Training, education and software costs, including operating manuals, maintenance manuals, training manuals?

Real estate costs, including purchase, lease or rent?

Service agreements and maintenance costs, vehicle and base station installations, telephone line installation, site preparation costs, labor costs, and training costs?

6.6 Have the following operating costs been determined:

Personnel costs, including supervisory personnel and supporting personnel?

Maintenance costs?

Utilities costs, electric, gas, telephone, leased lines, other?

Lease costs, including telephone equipment, real estate, vehicles and other equipment?

Supplies costs?

Training costs?

Financial costs?

Equipment replacement time frames, strategies and costs?

6.7 Have potential cost savings been identified?

Investments and accrued interest and pre-payments?

Operational savings and reductions, discounts?
_____ Has an economic analysis been made?

_____ Have the comparative cost/benefit evaluations been determined?
   Can these be summarized and presented in simple graphic form?
CHAPTER SEVEN of the regional plan should be titled SYSTEM DESIGN. The chapter should describe system elements. The description should include the expected performance as well as the electrical and mechanical features. An operational description for each element in the system should be prepared. Typical system elements include radio pagers, portable radios, mobile radios, base stations, mobile relays, radio control consoles, biomedical equipment, etc. The chapter should discuss the total number of each type and indicate where they are used or will be used in the system.

EXAMPLE OF SYSTEM DESIGN

After determining the communication requirements and reviewing the alternative equipment configurations, the system planner should put the basic elements together conceptually. As an example of how to do this, assume EMS communications are to be provided in a rural section of the state with much of the area remote and only sparsely populated. There are three population centers with a hospital in the largest one. There is a major highway which passes through the area. The requirements analysis determined the following:

- A basic life support EMS system will be provided.
- The system will use the VHF frequency band.
- The neighboring systems are all BLS and are on the VHF band.
- The exact amount of radio traffic is unknown but is believed to be only a few calls per day.
- Radio coverage is desired throughout the area, but is essential along the highway and in each of the population areas.
- The EMS calls will be dispatched by the fire dispatch center on the VHF fire frequency.
- The EMTs will contact the hospital by radio when they are on the scene.
- Telemetry will not be used initially but may be desired in the future.
- The budget allotted for equipment and installation is $50,000.
A review of the potential radio installation sites shows only a single site providing coverage over the entire area would also receive severe interference from adjacent systems. There is one other site which will cover about three-quarters of the desired area as determined by a computer coverage prediction model. Unfortunately, it does not cover one of the populated areas. This other site is also used by the state for their radio operations and they have been approached and have agreed to provide space for the base station and control circuits on the state microwave network. Except for the lack of coverage in the populated area, this site location meets all the requirements for a good site. A second base station could be located near the populated area. This area is located a considerable distance from the hospital and dedicated leased telephone control lines would be very expensive.

After considering the information available, it appears one approach would be to use a two-channel VHF base station at the state site and a telephone interconnected VHF base station located to provide coverage of the remaining area. The basic equipment list can now be developed as follows:

At the hospital:

A desk-top remote control console with -
  · Tone remote control
  · Emergency power operation or battery
  · CTCSS squelch disable switch (emergency receive)
  · Any other associated options required to be compatible with base stations

At the State site:

A two-channel VHF base station with -
  · Dual receivers
  · Tone remote control
  · CTCSS operation and CTCSS squelch disable
  · Battery backup and emergency power
  · Rotary-dial decoder or DTMF decoder (optional)
  · Time-out-timer
  · Isolator
  · Bandpass cavity

At the other site:

A single-channel VHF "dial telephone interconnected" base station with -
  · Telephone interconnect controller
  · CTCSS operation
  · DTMF decoder
  · Battery backup and emergency power
  · Time-out-timer
PLANNING EMERGENCY MEDICAL COMMUNICATIONS

DTMF decoder or secure system access
Dial telephone for radio call initiation

In the mobile units:

Multi-frequency VHF mobile radios with -
  CTCSS operation
  Rotary dial or DTMF encoder as required by telephone interconnect
  Time-out-timer
  Auxiliary control head in the patient compartment

At this point the overall system and operational features should be reviewed with the local system participants in the planning project, the state EMS section, and representatives from neighboring systems. Depending upon the complexity of the planned system and the availability of local technical assistance, a technical review might be appropriate at this point. This could be requested from the state EMS Section (or other governmental department) or from private independent communications consultants.
CHECKLIST

SYSTEM DESIGN

7.1 Has each system or sub-system been identified?

_____ Have electrical features and requirements been identified?

_____ Have mechanical features been identified including needed floor space, mounting surfaces, access, protection, and clearances?

_____ Has equipment and site security been considered?

_____ Have system performance and operational requirements been identified?

7.2 Has each system or sub-system element been operationally defined?

_____ Have human interface considerations been identified such as: visibility, speaker locations, noise considerations, storage and reach distances, clearances, sharp edges and padding, counter space, writing surfaces, cable storage and appearances?

_____ Have electrical and mechanical interfaces with other systems been identified such as ignition switch positions, master-switch requirements, current and circuit breaker requirements, mounting and convenience of operation?

7.3 Has the operating environment been considered for each system element?

_____ EMS mobile equipment compatible with other radio equipment in the vehicle?

_____ Climatic control and ambient temperatures, air conditioning, heating and venting of batteries and generators?

_____ Have insects, water, rodents, flooding, animals, vandalism, winds, icing, fires, lightning and other disasters been considered in locating equipment?

_____ Is the equipment appropriate when inactive such as: battery chargers, shelf life of batteries, storage and shore line considerations?
7.4 Has each system element been identified, defined or documented?

_____ Has the information been summarized?

_____ Have equipment and system cost estimates been prepared?

_____ Has the system element been presented in simple graphic form?
8 DEVELOPING A PROCUREMENT PLAN

CHAPTER EIGHT of the regional plan should be titled *PROCUREMENT PLAN*. The purpose of this chapter is to specify the type of procurement to be used, the content and scope of the bid package (i.e., specifications and administrative requirements), how vendor bids will be evaluated, and negotiation and contracting considerations.

It should be noted that state and local laws and regulations often dictate procedural steps in the procurement process. All such regulations covering competitive bidding, publication and notification of vendors, evaluation criteria, long-term payment limitations, contracting requirements, and affirmative action requirements (to name a few) should be carefully reviewed. In addition, depending on the agency that is assigned administrative responsibility for the procurement process, the appropriate legal advisor should be consulted.

PROCUREMENT PROCESS CONSIDERATIONS

Before determining the type of procurement to be used, the following consideration should be reviewed:

- **COMPLIANCE WITH LEGAL AND REGULATORY CONSTRAINTS**
- **EASE OF UNDERSTANDING**
  
  The procurement process and the objectives of the communications system should be clear and concise from the point of view of potential vendors, as well as of the government agencies involved. This will minimize the possibility of misunderstandings and protests.
- **EASE OF ADMINISTRATION**
  
  The procurement process should be as simple to administer as possible, and this will depend in part on the complexity or size of the planned communications system. The selection and evaluation criteria should be defined prior to the solicitation. The type of process used will also affect the security precautions which will be needed to safeguard proposals.
OBJECTIVITY

Objectivity of the procurement process is desirable for a number of important reasons:

- The evaluation of proposals will be accomplished more expeditiously if the procurement process is a highly objective one.
- The results of the procurement will be more readily concurred with by the various participating groups.
- Protests by unsuccessful bidders will be less likely if the procurement process is clearly objective.
- If protests do occur, the government agency’s decision is much more likely to be upheld if the procurement process can be readily shown to be objective.

However, while objectivity is desirable, the process should not exclude the use of experience and informed judgment.

FLEXIBILITY

The telecommunications industry experiences rapid changes in terms of technology, costs, and regulation. It is desirable that sufficient flexibility be built into the procurement process to take advantage of various innovations and cost containment alternatives that may occur.

Flexibility should also be provided to allow clarification or amendment of proposals to facilitate competition.

MAXIMIZATION OF COMPETITION

The procurement process should be designed to ensure competition, including technical and price competition, and not inadvertently eliminate or penalize certain vendors.

REDUCTION OF RISK

In addition to the risks of bidder protests, the procurement process should be designed to safeguard against the selection of an unqualified vendor, selection of vendors with insufficient resources, and selection of vendors which cannot implement the desired system in the specified timeframe.
The overall objective in the procurement of a new communications system is to get the best overall system for the lowest cost. Additionally, the type of procurement will be determined by the size and complexity of the planned system and the objectives of the planners and users of the communications system. Generally it is recommended that some form of competitive or formal advertising and procurement process be used. The use of "sole-source" procurement is, however, justified in some instances. For example, use of a state standard purchase order essentially is a sole-source procurement from a standard list. In addition, some equipment purchases are too small to warrant a full-scale competitive effort, and in some cases there might be only one source of certain types of equipment. An "emergency" requirement for specific equipment is another reason to forego a lengthy competitive bid process.

There are various methods used for competitive procurement by governmental agencies. Some of these methods are described in Appendix A. Keep in mind that some methods are very similar, often differing in name only. The methods are:

1. Invitation-to-Bid (ITB) or Request-for-Bid (RFB)
2. Request-for-Proposal (RFP), Low Bidder if technically acceptable
3. Two-Step Request-for-Proposal (RFP)
4. Modified Two-Step Request-for-Proposal (RFP)

BID PACKAGE

Regardless of which procurement process is used, a bid package should be prepared and include the communications system specifications and operational requirements. Even if there appears to be only one vendor capable of providing the planned system, it is prudent for the governmental agency to define in writing exactly "what it wants" and "when it wants it" in as much detail as possible. If the regional plan has been properly prepared, this information should be available. In addition, unless detailed specifications and delivery schedules are defined, project monitoring and settling vendor disputes can be very difficult.

The bid package can be organized in any number of ways, but generally should contain three basic sections and types of information as follows:

Section 1 - General Instructions, Instructions on Bid Submittal, Name of Purchaser, Project Background, Bid Requirements and Bid Deposit, Performance Bonds, Scope of Work, Time Schedules, Delivery Requirements, Definition of Terms, System Responsibility Requirements, Penalties, Payment Schedules, Insurance Requirements, Indemnifications, Evaluation Criteria, and Administrative Instructions

Section 2 - Vendor Instructions, Bid Forms, Price Sheets, Reporting Requirements, General Requirements, Standards Requirements

NATIONAL ASSOCIATION OF STATE EMS DIRECTORS
Section 1 is self-explanatory. It should contain the "why, what, who, where and when" type of information needed for proposing and bidding on the system. Any special or minimum vendor requirements, over and above the technical system specifications, should be enumerated. For example, vendor geographic locations, response times for maintenance, previous experience with similar systems, etc. The proposal evaluation criteria should be explained and should cover compliance with technical and performance specifications, compliance with implementation timeframes, and the requirements for ongoing support and/or maintenance. General criteria such as successful and recent experience with similar type and size of projects should be listed. Detailed cost data should be requested, but the timing for submission will depend on the type of procurement process used.

Section 2 should contain the various instructions needed to prepare a bid or proposal. The instructions should cover the due date and specific place of submission (received by a specific date at a designated location); the format required for submission, including a description of the procurement process (i.e. a two-step process where the technical submission is required initially and a separate cost proposal submitted later); rules governing late proposals and acceptability; and, required signatures of company officials; the date of any pre-proposal conferences (if conducted); bonding requirements and bid deposits; proprietary information notations; responsibility and costs for preparation (i.e. the issuing agency not responsible for preparation costs or held liable for information); how many copies of the proposal are required; and address or locations to submit the proposal and bid; and any other general instructions, requirements or information.

Section 3 covers the area of contract requirements; special provisions such as conflict of interest; restrictions on previous government employment; the use of subcontractors; and payment schedules. The scope of work section of the vendor's proposal often becomes part of the actual contract. The contract usually defines the terms and parties; lists remedies for termination for cause or convenience; sets forth procedures for determining liabilities; specifies any special invoicing requirements; and specifies contract modification procedures.

Another aspect of preparing the bid package which is often overlooked is the compiling of a complete list of the vendors capable of performing the planned project. The public advertising of the ITB/RFB/RFP is also a related consideration. In both cases the objective is to assure that competition is maximized, with public notices prepared (most jurisdictions have designated official newspapers for legal and procurement notices) and efforts made to send bid packages to all interested vendors. A due date for the vendor responses should be set, keeping in mind possible delays, such as post office delay, when vendor request for proposals are mailed. The response time should include adequate time for the bidders to prepare complete responses and assemble necessary technical information.
EVALUATION OF BIDS

A number of considerations in the bid evaluation process have been mentioned so far, including the concerns for objectivity, flexibility, and ease of understanding and administration. Also, the type of procurement selected will have an bearing on evaluation.

The evaluation criteria, a planned scoring method, and an evaluation/selection committee should be established prior to the distribution of the bid package. It is desirable to have at least one member of the committee, or staff support to the committee, capable of analyzing the technical presentation from the bidder’s submission. This is especially true when a complex communications system is being procured and there is more than one equipment or system configuration which could meet the stated specifications and performance requirements.

Use of the Two-Step Request for Proposal, or Modified Two-Step method, simplifies the evaluation process by having the final decision based on lowest cost, after the bidders technical proposal has been evaluated and qualified. The key difference between this method and others such as the ITB/RFB or the "Low Bidder if Technically Acceptable," is that there is usually no opportunity to "standardize the proposed system." This requires a point-scoring or ranking system. The difficult part of such a ranking or scoring system is taking into account qualitative differences, different features of certain vendor's equipment, and how to relate such differences to proposed costs. There is no simple or easy way to construct a ranking or scoring system. The ranking plan is often divided into categories such as basic/mandatory requirements; experience; work approach; staffing; and costs. These are weighted using a point scoring approach.

The Two-Step Method appears to eliminate some of this scoring problem, but still requires a careful and detailed attention to the technical qualifying information. Each criteria for evaluation is established before the proposal or bid is opened. Then the technical proposal is evaluated and qualified as acceptable. Only after the "acceptable" technical proposals are identified are the corresponding cost proposals opened.

Despite careful formulation and evaluation procedures, unsuccessful bidders may sometimes protest a purchase award. Vendor notifications and awards should then be made on the basis of "apparent successful bidder" and then finalized after adjudication of any protests. All bidders should be notified in writing of all purchase awards or protests.

NEGOTIATIONS AND CONTRACTING CONSIDERATIONS

Assuming that the foregoing steps in the procurement planning process have been accomplished, the negotiation stage should proceed rather smoothly. However, with the complex and rapidly changing technologies involved in the telecommunications industry, several additional factors should be considered. While a standard contract will serve as the basic contractual agreement, the following general objectives should be included:

NATIONAL ASSOCIATION OF STATE EMS DIRECTORS

= 72 <
How project process will be measured and provisions for interim payments established

What penalties, including liquidated damages, will be involved if the vendor or system does not perform as specified

Design of a provision to ensure that the vendor has an incentive to reduce costs wherever possible

Development of a process to allow for future system changes (to incorporate technological advances, for example) to be authorized and controlled

Approaches to meet these objectives will vary with each system procurement, but the agreed-upon method should be clearly spelled out in the formal contractual agreement. Specific persons should be designed to perform the contract monitoring tasks, and one single responsible vendor representative should be designated within the contract.

The government agency administering the procurement process should also notify all vendors of the final award and should be prepared to explain the scoring process and "debrief" any vendors requesting information.

Another aspect of the contracting process is the contract monitoring function. As stated above, a person should be designated to carry out these tasks, and periodic reporting covering vendor compliance with installation schedules, budgets, and agreed-upon change orders should be provided to the Project Steering Committee or responsible officials.
CHECKLIST

PROCUREMENT PLAN

_____ 8.1 Have applicable State and local procurement laws, rules and regulations been reviewed?

_____ 8.2 Has appropriate legal counsel of planned procurement been identified and alerted?

8.3 Have objectives of procurement considerations been determined, including:

_____ Compliance with legal and regulatory constraints?

_____ Ease of administration?

_____ Ease of understanding?

_____ Objectivity?

_____ Flexibility?

_____ Maximization of competition?

_____ Minimization of risk?

_____ 8.4 Has the appropriate type of procurement been determined?

8.5 Have the following components of the bid package been prepared?

_____ General Instructions

_____ Instructions on Bid Submittal

_____ Name of Purchaser

_____ Place for Bid Submission

_____ Provision Pre-bid conference

_____ Project Background

_____ Bid Requirements
8.6 Has an evaluation process been prepared?

_____ Selection Committee Designated
_____ Technical support identified
_____ Preparation and documentation for any protests

8.7 Have the following negotiations and contracting considerations been completed?

_____ Notify all vendors
_____ Prepare contract
_____ Sign contract
_____ Designate contract monitoring officials
9 DEVELOPING A FUNDING PLAN

CHAPTER NINE of the regional plan should be titled PROGRAM FUNDING. The purpose of this chapter is to identify the resources required to actually implement and operate the planned EMS communications system, the sources of the funds, how best to utilize the resources (i.e. rent, lease, or purchase decisions which in turn affect the required funds needed over time), and how the funds will be budgeted and managed.

RESOURCE REQUIREMENTS

The required resources in terms of monetary amount, staff commitments from participating agencies, and facilities will be determined by the type of system and its various elements and configuration. A projected cost should be prepared for each component of the system and for the entire planning through operational cycle; including purchase, installation, site preparation, system testing, and ongoing operational and maintenance support. If the intended installation testing date is more than six to nine months away, price increases should be factored into the projected costs. Similarly, the use of State standard purchase contracts and discounts offered to governmental agencies should be included in cost estimates. It is typical for staff members of involved agencies to participate in the planning steps for a new or enhanced communications system and also in the installation, testing, and "fine-tuning" of the equipment. The expected involvement of such staff resources should be carefully identified, to ensure that the allocated time will not detract from regular job duties.

Displaying the resource requirements on a resource requirements summary chart is recommended. This facilitates mutual understanding as well as helps ensure that no category or type of resource has been overlooked. A separate summary chart should be prepared for financial, staff, facility, and administrative requirements. The resource requirements summary chart should be formatted to cover all aspects of system procurement, installation and testing, and operations. Restrictions may exist on the use of funds from some sources such as a federal grant, for various cost categories. For example, costs for real property or construction may not be eligible for funding from federal "non-construction" grant programs. Also, some federal grant programs limit use of funds for certain operating expenses. As an aid in seeking appropriate funding sources, costs should be categorized and tabulated as "Acquisition, Construction, and Improvement" (A C & I), or as "Operating Expenses." For development of project budgets, it is also necessary that funding time-lines be developed for both recurring and non-recurring costs. A "life-cycle cost" summary also helps to ensure that system costs are not overlooked. Generally, the more detail and thought devoted to the listing of the resource requirements, the more accurate cost projections become.

NATIONAL ASSOCIATION OF STATE EMS DIRECTORS
After the level of equipment (and other monetary) requirements is determined, the timeframe constraints and requirements should be analyzed, keeping in mind options such as renting, leasing, or purchasing. The availability of funds or grants is one factor in this analysis, and leasing (or lease/purchase) options allow the system costs to be stretched over a multi-year period. Another factor is the useful life of certain types of communications equipment, which can be impacted by expected development of more advanced or less expensive alternatives. If this is the case, a lease/rental agreement with a suitable termination clause might be advantageous to ensure that the EMS agency is not locked into outdated equipment. Other factors, such as the "interest" or "carrying" fees for governmental agencies, must be taken into account when determining the most beneficial funding method.

IDENTIFICATION OF RESOURCE SOURCES

Once the amount, type, and time requirements of resources have been determined, the source (organizations or providers) can be designated. Potential sources can range from governmental agencies at the local, regional, State or Federal level; special grants; private foundations or individuals; or special tax assessments. The amount of resources should be allocated by system component and tasks and categorized by financial/non-financial (with non-financial resources primarily consisting of "loaned" staff support, facilities, or equipment sites). Often it is necessary to seek funding from various sources. A funding availability plan listing the amounts, purpose, and expected time of availability for funds from various sources should be developed. In seeking funds from state or federal sources it is important for applicants to identify funding requirements in terms of specific cost categories. Listings of the cost categories that should be identified in a grant application should be requested from State or Federal agency from which the grant is sought.

PROJECT BUDGET

A formal budget should be prepared. The information gathered for the financial resource requirements (and the time period in which they are expected) provides most of the raw data. These monetary requirements then must be translated into an estimated monthly expenditure plan, or budget, for the entire length of the developmental project.
FINANCIAL MANAGEMENT SYSTEM

The budget, in turn, provides the information required for a financial management system to monitor and control expenditures throughout the duration of the developmental project; this system could be continued after the normal operations have begun. While several agencies are usually involved in the planning and design of a regional (or even local) EMS communications system, it is suggested that one be designated as the "budget control agency." This agency will receive and expend the project funds and will be responsible for preparing monthly (or periodic) financial reports on the "budgeted versus actual" expenditures based on the project schedule. These reports must be forwarded to specific officials in the participating agencies or to a project steering committee if one has been formed.
CHECKLIST

PROGRAM FUNDING

_____ 9.1 Have resource requirements by amount, type, category, and time-line been identified and tabulated?
_____ 9.2 Has the financial analysis (lease versus procurement analysis) been performed?
_____ 9.3 Have funding sources been identified?
_____ 9.4 Has a funding availability plan been developed?
_____ 9.5 Has a project budget been prepared?
_____ 9.6 Has a plan for fiscal monitoring, management and reporting been prepared?
CHAPTER TEN of the regional plan should be titled *IMPLEMENTATION PLAN*. The Implementation Plan should contain: a statement of work which defines the specific tasks to be performed; a schedule which displays the task sequence and the calendar period covered; and an assignment of responsibility, indicating the persons responsible for accomplishing certain activities.

The implementation plan prepared as part of the regional plan must be comprehensive and detailed and should follow the logical sequence of events, although some tasks can occur simultaneously.

Communication system projects often take an extensive period of time before they "take shape" and are classified as a formal project. During this period, a number of plans, feasibility studies, or concept papers might be prepared. These may serve as a preliminary or "rough" implementation plan, concept development papers and schedule outlines. While these documents serve to get the project "off the ground," a formal implementation plan ultimately should be prepared and approved.

**STATEMENT OF WORK**

The statement of work should list the tasks required from start to finish for the overall project. Each major task is generally listed in terms of an action statement and is often broken down into subtasks with a brief description of the scope of the task. The content of the *Statement of Work* will depend on a number of factors, including:

- Size and complexity of the EMS communications system
- The number of participating agencies
- Whether the system is new or an enhancement to an existing system

In general, however, the steps or tasks outlined in this planning guide provide a general starting point for the statement of work.
SCHEDULE

After the specific tasks are identified, a schedule should be prepared. The schedules reflect both the sequence of events and a timeframe, which can be expressed in weeks/months from the project start date or actual calendar dates. Prime concerns for the schedule preparation are that available staff resources should not be overloaded and that tasks, some of which can be accomplished simultaneously, should be in a logical sequence depending on their requirements for information or decisions from a prior task.

ASSIGNMENT OF RESPONSIBILITY

The final aspect of preparing the implementation plan is to assign responsibility for each task and subtask to a particular individual. Depending on the nature of the task, responsibility might involve direction or coordination of additional resources or actually performing the tasks. However, the person assigned to a particular task should have the responsibility to ensure completion within budget and schedule.

CHECKLIST

IMPLEMENTATION PLAN

_____ 10.1 Has the Statement of Work been prepared?
_____ 10.2 Has the schedule been defined?
_____ 10.3 Have responsibilities for all tasks been assigned?
11 DEVELOPING PROCUREMENT SPECIFICATIONS

CHAPTER ELEVEN of the regional plan should be titled PROCUREMENT SPECIFICATIONS. In most cases it will be appropriate to prepare the specifications as a separate document and to provide only a reference to that document in the regional communications plan. In other cases no procurement may be required, when only reconfiguration of existing equipment is needed, and no purchase of new equipment is anticipated. Procurement specifications may still be required, however, to document the work to be contracted or performed for the reconfiguration.

The specifications should describe what the system must do in specific terms which can be used to solicit competitive bids for services or equipment procurement, including how the system should operate (configuration), how well the system should operate (performance) and what the equipment characteristics should be (design). In addition, the specifications should also describe where the equipment will be installed and how the equipment will be installed and tested. Procurement specifications should be performance oriented where possible and should describe what the equipment or hardware is to do functionally. Accurate quantities and definitive specifications such as the size of components, weight, etc. should be included when they influence design or operation, or have absolute limit or constraint due to space or loading. It is sometimes possible, in the interest of establishing competition and reducing prices, to break the procurement specifications into several categories such as consoles from one manufacturer, mobile units from another, towers from another, etc. If such an approach is followed, it is necessary to carefully define the interface between the components and establish responsibility for total system operation. This is sometimes accomplished through payment schedules being tied to operational testing and function. This approach must also be examined in light of potentially increased administrative costs required to organize and monitor complex and inter-related tasks. There is a requirement for increased technical ability, required to interact with various suppliers, and eventually a risk that the complete system function may not be achieved due to the failure of a single supplier unable to perform his function, while all other suppliers appear to have performed operationally.

PREPARATION OF SPECIFICATIONS

Prior to undertaking the development of a new set of specifications, the planner should contact the state EMS office to see if some or all of the equipment is covered by a currently open State purchase contract. If so, the prices, terms, and conditions are likely to be highly favorable, and the planner should consider purchasing equipment through the state contract. First a check should be made to confirm that the State specifications cover
If a state contract cannot be used directly, the next step would be to check with the State EMS Section or communications division or office in other state agencies (such as Highways or Forestry) to determine if they have model bid specifications which could be used or adapted for use. If so, the planner can save time in preparing the specifications and can benefit from the experience the other agency may have gained in using those specifications in previous procurement. The final alternative would be to prepare new specifications.

ELEMENTS OF A SPECIFICATION

The specification should follow a format similar to that described below and should contain, as a minimum, the type of information identified under each heading.

GENERAL INFORMATION

Each procurement document should contain general requirements, equipment specifications, a system description and an equipment list. This document addresses the first two components listed - general requirements and equipment specifications. These sections will be standard for each county or region bid package prepared. The second two components, system description and equipment list should be individually prepared for each procurement, and will be based on the county communications plan.

ORGANIZATION OF BID PACKAGES

Each bid package should be organized as follows and all items listed below should be included. Some items must be compiled individually for each procurement at the time of implementation.

NOTIFICATION OF SOLICITATION

List the companies that should receive copies of the bid package. Date of issue and issuing agency should be inserted when the procurement process is initiated. The date should be revised for identification with any subsequent revisions or reissues.
BID PACKAGE CONTENTS

List the general sections similar to a table of contents. List each individual equipment specification included in the bid package. Each specification or section should include a revision date if specifications are obtained and used over a period of time.

LEGAL ADVERTISEMENT

The purchaser must advertise the bid according to state and local laws. A legal advertisement which will identify dates and times for the bid conference and bid opening, and other required information should be included.

BID FORM

A bid form for the total bid price quotation of all items to be delivered or supplied signed by the bidder. The bid form should contain a statement of agreement to the terms and conditions of the bid package specifications and requirements and a statement of guarantee by the bidder for a complete operating system for the prices quoted. The bid request number, date, and the title of the procurement should be included.

PROPOSAL REQUIREMENTS

This is a checklist specifically identifying the information that must be included in the bidder's proposal. A reference to the paragraphs of the bid specifications where the information is noted should be included. A non-conclusion affidavit should be included for completion by the bidder.

GENERAL INSTRUCTIONS AND CONDITIONS

These are complete instructions for submittal of proposals, requirements for bid deposits, performance bonds, delivery and installation schedules, maintenance system responsibility, etc.

EQUIPMENT LIST

A complete detailed list of all required equipment must be prepared using information from the local communications plan. The list should be formatted for the
bidder to identify the make and model numbers, quantities, accessories, hardware, installation, and maintenance prices for each equipment item.

GENERAL SYSTEM REQUIREMENTS

This defines the overall technical requirements of the system and equipment, including applicable standards, workmanship requirements, guarantees, installation and maintenance requirements, radio coverage requirements, and specific operational requirements.

SYSTEM DESCRIPTION

This is a description of the complete system, based on the local communications plan. Operational requirements, location of equipment, antenna sites, and frequency assignments all should be identified. System diagrams should be included in the system description.

EQUIPMENT SPECIFICATIONS

Complete technical specifications for each equipment item required should be included in the bid package.

FACILITIES SPECIFICATIONS

When buildings, radio towers or other structures are to be erected or modified, the services of a licensed architect and engineer should be obtained for the preparation of any building plans, drawings, and specifications. Construction and erection contracts should be negotiated separately from the electronic hardware and software contracts, due to significant differences in contracting methods and procedures. The services of an architect will help protect against violations of building codes, zoning restrictions, and damage that might arise from faulty modifications to the structural integrity of existing buildings. This professional service will also provide architectural integrity with the surrounding environment and can include considerations to withstand natural disasters. It may additionally be prudent to obtain the services of professional soil engineers or surveyors. This is particularly true when locating radio towers and determining footing, anchor and guy wire requirements.

INTERFACE SPECIFICATIONS

The interface specifications should include all electrical, performance, mechanical,
and man-machine interfaces in the system. The interfaces include those at the
dispatch center, remote base station site, the vehicles, and the operating personnel
at each of these locations, including ambulances.

TRAINING SPECIFICATIONS

When a change of equipment or system operation is involved, the need for training
for operating and maintenance personnel should not be overlooked. Training
courses in operation and maintenance can be contracted as a part of the hardware
procurement. Training materials and documentation such as maintenance manuals
should also be obtained under the contract to meet future retraining and
maintenance needs.

DOCUMENTATION SPECIFICATIONS

The procurement specifications should contain provisions for delivery of adequate
manuals and documents needed to support the system and equipment during its
operational life. Documentation should include equipment manuals containing
operating instructions, theory of operation, schematic diagrams, wiring diagrams
and parts lists. It should include diagrams for interconnection between equipment.
All installed cabling should be permanently labeled.

TEST AND ACCEPTANCE REQUIREMENTS

The two basic levels of test that concern the planner are system tests and
equipment tests. If a parameter is specified for the system or the equipment, its
importance is assumed to be such that verification by test is justified. The
predominant tests are the system performance tests. These are followed in
importance by the equipment performance tests.

The agency with no testing capability of its own can specify that the supplier is to
perform the tests in such a manner that they can be observed by representatives of
the procuring agency. Alternately an independent consultant can be retained to
either perform the tests or monitor the tests conducted by the supplier.

The specification should include the criteria for both accepting and rejecting the test
results. The procedure to be followed in the event of a test reject should be clearly
specified. If acceptance is based solely upon certification of performance by the
vendor, procedures to be imposed if lack of performance later places the
acceptance certification in doubt should also be specified.

Base and mobile tests of radio coverage should not be undertaken until newly
installed base and mobile equipment have been checked thoroughly for normal operation, including verification that the antenna, transmission line, and radio transmitter and/or receiver are properly matched. All base station and mobile test results should be recorded for future reference.

The most significant acceptance test of a base and mobile system is verification that base and mobile communications are adequate to the intended minimum limits of coverage with no unintentional interference with other agencies on the same or adjacent channels. These conditions must be specified system parameters in order to be part of a systems acceptance test procedure. The system should be designed around and tested for mobile talk-back performance. Field tests should show that the system meets or exceeds the specified field intensity previously mentioned.

If maximum system delays have been specified, statistical data must be collected over a significant period of time to establish the test data (for example, the maximum delay in obtaining a clear channel or in servicing a request for assistance). These testing parameters also should be defined in the specifications together with procedures for clearing and correcting test failures.

All specified functions of the system and equipment should be tested for conformity with the specifications. If the test plans do not include the verification of a specified parameter, consideration should be given to the removal of the parameter from the specification.

Some of the parameters of prime importance that should be tested include transmitter power output and receiver sensitivity. The correct frequency of transmission and reception should be verified according to the FCC Rules and Regulations.

VENDOR RESPONSIBILITIES

Vendor responsibilities should be clearly stated and include, but not be limited to the following:

1. System design to meet the stated function, coverage, and specification parameters. All technical parameters and methods used to design the extent and quality of radio coverage should be contained in the vendor's response to the request for proposal or bid. If the vendor has full system responsibility they should be required to guarantee the system design with system performance bonds.

2. All participating vendors should be required to attend a pre-bid meeting or conference. Prior to this meeting all vendors should submit any questions they may have concerning the bid specification documents or the required system performance in writing. At the pre-bid meeting the procurement
document should be reviewed and amended, if necessary. All amendments or changes to any specification must be documented in writing and attached to the specifications. Copies of the amendments should be provided to the bidders prior to the bid opening date. If possible, topics other than those submitted in writing prior to the meeting should not be discussed. If possible, only those vendors represented at the pre-bid meeting should be permitted to submit a proposal or quote.

! Vendors should guarantee compatibility of any hardware supplied with existing system or equipment in use.

! Vendors should to be required to meet a reasonable time frame in supplying, installing, and making the system operational. Deadlines should be reasonable and should be specified in the bid specifications and documents.

EXISTING SYSTEM INFORMATION

If there is an existing system that is to be modified or expanded, a functional description of that system and a list of equipment used should be included in the bid document.
8.1 Are state-level purchasing contracts available for the procurement of equipment?

8.2 Do state or local level agencies who traditionally buy telecommunications equipment and have standard specifications available?
   - State EMS office?
   - State Police?
   - State Highway Department?
   - Large municipal agencies?

8.3 Is a source of information available for the preparation of equipment procurement specifications?
   - From other State agencies?
   - From outside contractor?
   - From planning agency staff?
8.4 Have all elements been included in the specification document?

_____ Is the introduction to the procurement needs complete?

_____ Are system and equipment performance parameters complete?

_____ Are specialized specifications for computer subsystems complete?

_____ Are facility needs specifications complete?

_____ Are system interface specifications complete?

_____ Are training specifications complete?

_____ Are documentation and manuals detailed and comprehensive?

_____ Are test and acceptance specifications complete?
INVITATION TO BID (ITB) OR REQUEST FOR BID (RFB)

Under an ITB/RFB approach, the procuring agency provides all specifications of its requirements in the invitation for bid and asks only that responding bidders provide a price (or prices) for the equipment/system and concur with the ITB/RFB requirements. The lowest bidder is successful. This type of procurement becomes difficult if bidders take exception to the specification requirements, which is not permitted in this procurement approach. Careful attention to preparation of specification requirements is therefore required.

The ITB/RFB approach provides no opportunity for bidders to modify the specifications, nor does it allow consideration of qualitative differences between bidders. Provided a bid meets or exceeds the specifications, it is acceptable, and price becomes the only consideration.

The ITB/RFB approach is the most frequently utilized procurement approach for commodities and other items where specifications can be readily defined. It is not usually used for procurement of services or systems where there may be significant qualitative differences between bids.

LOWER BIDDER IF TECHNICALLY ACCEPTABLE

This is essentially a modified form of the ITB/RFB approach but requires bidders to demonstrate that the service or products bid complies with the specifications and conditions of the ITB/RFP. Thus, for a procurement of service or technical communications systems, bidders would be required to submit both a technical "proposal" and a price or cost "bid." The bids are opened to determine the low, and therefore apparently successful, bidder. The low bidder's technical proposal is then examined to determine if it meets the specifications included in the ITB/RFP. If it does, the contract is awarded to the low bidder. If the specifications are not met, the review and analysis process is repeated for the next lowest bidder, and so on.
TWO-STEP REQUEST FOR PROPOSAL

Under the two-step approach, technical proposals are solicited first. The technical proposals are then reviewed and qualified proposals are selected. Possibly after modification of technical requirements, details are developed under a formal specification documentation process. Price bids are then requested only of the qualified proposers as determined by the reviewed technical proposals. The lowest price bid is successful.

The two-step approach has been used primarily for complex equipment procurement, in which the procuring agency anticipates that proposers may not fully meet all the specifications because of the complexity involved. The two-step process provides an opportunity for the procuring agency to ensure that all specifications are met by as many proposers as can reasonably meet the requirements. This is a complex and time consuming procurement process, often requiring numerous meeting and negotiations.

The two-step approach involves the following procedures:

! A "Request for Technical Proposal" is first issued with instructions

! Technical proposals are then received and evaluated to be

∃ acceptable, or

∃ susceptible to being made acceptable, or

∃ unacceptable

! Proposers with proposals in the second category are given the opportunity to correct and/or clarify their proposals (remember, at this point no costs or prices have disclosed)

! Following correction and/or clarification, the "susceptible" proposals are reclassified as:

∃ acceptable, or

∃ unacceptable

! An "Invitation For Bid" is issued only to those entities submitting technical proposals classified as "acceptable technical proposals"

! Bids are submitted and opened
MODIFIED TWO-STEP

The modified two-step Request for Proposal process requires simultaneous submission of technical and cost proposals and is designed to be an accelerated version of the two-step process.

The modified two-step approach involves the following procedures:

- A Request for Technical Proposals (RFP) and Invitation for Bid (IFB) is issued.
- Technical proposals opened, evaluated and categorized as:
  - acceptable,
  - able to be made acceptable with clarifications only, or
  - unacceptable
- Proposers with proposals in the second category are asked to clarify details of their proposals (but amendments are not allowed)
- Following clarifications, the clarified proposals are reclassified as:
  - acceptable, or
  - unacceptable
- Cost proposals (bids) corresponding to only the acceptable technical proposals are then opened.
- The low bidder is successful

The effect of this process is very similar to that of the "Low Bidder if Technically Acceptable" but provides a more detailed review of all technical proposals.
APPENDIX A - TYPES OF PROCUREMENT PROCESSES

APPLICABLE DOCUMENTS


United States Department of Transportation, National Standard Curriculum, EMT-Intermediate, Revised 1985

United States Department of Transportation, National Standard Curriculum, EMT-Paramedic, Revised 1985

United States Department of Transportation, National Standard Curriculum, First Responder, 1995

United States Department of Transportation, National Standard Curriculum, Emergency Medical Dispatch, 1995


INDEX

| A | advanced life support | 21, 30, 33 |
|   | ASTM | 1, 100, 101 |
|   | auto-patch | 44 |
|   | automatic battery reverting | 41, 43, 44 |
| B | bandpass cavity | 56, 66 |
|   | basic life support | 30, 33, 65 |
|   | battery power | 41 |
|   | bid form | 89 |
|   | bid package | 71, 73, 75, 78, 88, 89, 90 |
|   | biomedical telemetry | 34, 59 |
|   | budget control agency | 83 |
| C | CDCSS | 16 |
|   | cellular telephone | 35, 59 |
|   | certification | 30, 92, 100 |
|   | channel congestion | 62 |
|   | checklist | 22, 24, 27, 32, 36, 59, 68, 78, 84, 86, 89, 95 |
|   | citizen access | 11, 30, 36, 59 |
|   | CMED | 47 |
|   | continuing education | 7, 8 |
|   | continuous tone-controlled squelch | 15 |
|   | cross-band repeating | 50 |
|   | CTCSS | 10, 15, 16, 17, 30, 36, 40, 41, 43, 44, 45, 46, 48, 55, 66, 67 |
| D | directional antenna | 58 |
|   | disaster plan | 6, 7 |
|   | disasters | 8, 13, 15, 40, 68, 91 |
|   | dispatchers | 7, 8, 18, 100 |
|   | DTMF | 15, 40, 44, 45, 55, 66, 67 |
|   | duplex | 12, 46, 48, 51 |
| E | EACOM | 41 |
|   | eligibility | 19, 100 |
|   | EMD | 30 |
|   | emergency medical dispatch | 8, 100, 101 |
|   | Emergency Medical Radio Service | 19 |
|   | emergency operation center | 14 |
|   | emergency override | 40 |
|   | emergency telephone | 11 |
|   | EMS dispatch | 13, 30, 36 |
|   | evaluation of alternatives | 39, 59 |
|   | executive summary | 21, 22 |
| F | feasibility studies | 85 |
|   | Federal Communications Commission | v, 16, 17 |
|   | first-tier | v, 1 |
|   | frequency band | 33, 45, 65 |
|   | frequency coordination | 31, 37, 58 |
|   | frequency usage table | 27 |
|   | frequency use | 26 |
|   | funding | v, 2, 7, 54, 81, 82, 84 |
| G | generators | 15, 68 |
|   | geographic coverage | 30, 52 |
|   | goal | 21, 29 |
|   | grant funds | 7 |
| H | HEAR | 41, 46, 47 |
|   | hospital communications | 36 |
| I | implementation plan | 3, 85, 86 |
|   | IMSA/IAFC | v |
|   | incident command communications | 12 |
|   | inventory | 2, 18, 25, 26, 27 |
|   | isolator | 56, 66 |
| J |  |
| K |  |
INDEX

- V -

vehicular repeater ........................................... 49
VHF base station ................. 15, 41, 56, 66
VHF system ................................................. 34, 41

- W -

- X -

- Y -

- Z -