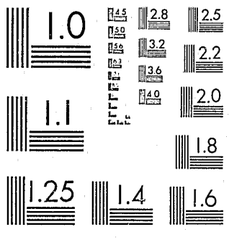

SYSTEM IMPLEMENTATION PLANNING GUIDELINES

PROJECT 16B

of the

ASSOCIATED PUBLIC-SAFETY COMMUNICATIONS OFFICERS, INC.

Prepared by

BOOZ•ALLEN & HAMILTON, INC.

LAW ENFORCEMENT ASSISTANCE ADMINISTRATION

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SYSTEM IMPLEMENTATION PLANNING (SIP) GUIDE

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The professional competence and dedication to the public's service shown by all of the participants in this project reflect great credit upon the telecommunications profession.

APCO wishes to express its appreciation to the following individuals for their contributions to the field of public safety:

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SECTION I

INTRODUCTION

I. INTRODUCTION

The purpose of this guide is to assist telecommunications planners in local communities in planning and executing a successful implementation of a new, technologically complex telecommunications system, specifically a Digitally Addressed Trunked Communications System (DATCS). The guide is oriented toward the implementation of a telecommunications system for a collection of public-safety and/or local government agencies.

This SIP Guide was developed as part of APCO Project 16B in which four communities (Lexington, Kentucky; Bucks County, Pennsylvania; Salt Lake County, Utah; and Phoenix, Arizona) along with the State of Oklahoma each undertook the development of a DATCS System Implementation Plan (SIP) with the assistance of APCO. In concert with the development of the individual SIPs, this guideline was prepared to reflect the necessary planning and implementation steps as experienced in development of the individual plans.

1.1 OBJECTIVES OF THE GUIDE

The SIP Guide is intended to provide a recipe to be followed by local planners who have responsibility for the implementation of advanced telecommunications systems. Assuming that the community has decided to develop a new, advanced system to solve current problems or meet anticipated needs, the guide will assist the implementation manager in:

- Program Planning
- Project Management
- System Implementation.

Although the guide was prepared to address the implementation of a DATCS radio system, it is sufficiently general to be of use to all agencies as a model for implementing any advanced technological systems.

1.2 ORGANIZATION AND USE OF THE GUIDE

Sections II and III of this guide discuss the activities related to the conceptual design of the new system and the development of a system implementation plan (SIP) for a new system. The general outline of a system implementation plan is shown in Exhibit I-1.

Section II of the guide will aid the community in defining an acceptable system concept for the new system. It provides guidance in organizing for project management securing agreements of participation of the appropriate agencies and developing a master project schedule. It then describes the project activities required to develop and document an appropriate system concept which is acceptable to all participating agencies.

Section III of this guide will not only assist the planners in the development of the SIP sections related to specific implementation acitivities, but will also assist the implementation manager throughout the implementation project. When the system concept has been approved and the community has decided to implement the new system, Section III of this guide will assist the implementation manager in planning and managing the required steps in the implementation process.

A useful System Implementation Plan developed by an individual community will represent the results of having successfully completed the activities discussed in Section II of this guide. In addition, the System Implementation Plan will contain an initial plan for all the implementation activities discussed in Section III of the guide. The amount of detail to be included in Section III of an individual System Implementation Plan should be sufficient to provide confidence in the ability to complete the implementation activities in accordance with the plan.

EXHIBIT I-1
SIP GUIDELINE

I. INTRODUCTION

- Project Background and Objectives
- Project Director and Participating Agencies
- Management Authority and Responsibilities

II. SYSTEM CONCEPT (DATCS)

- Diagram/Configuration
- Concept of Operation
- Detailed System Description
- External Interfaces
- Management and Personnel
- Funding Requirements

III. REQUIRED IMPLEMENTATION ACTIVITIES

- Implementation Schedule
- System Management and Operation
- Funding
- Procurement
- Facilities Acquisition and Preparation
- Personnel and Training
- Post Implementation Support

APPENDICES

- Current System Inventory
- DATCS System Requirements
- Statement of Work (SOW)
- Agency Agreements

SECTION II

SYSTEM DESIGN ACTIVITIES

II. SYSTEM DESIGN ACTIVITIES

The planning environment for the development of a high technology system such as a trunked radio system assumes that the principal user organizations (public-safety agencies) have recognized the need for communications system improvements and have demonstrated that these improvements are not obtainable through traditional or established radio system practices. Therefore, these organizations will have considered trunked radio systems as a probable solution. The project can be divided into activities related to the conceptual design of the telecommunications system and activities related to the implementation of the system. These two are not mutually exclusive functions but instead are supportive of each other in a number of ways. The four major elements of the development of the new system design concept are:

- Formation of an Organization for Management of System Design Activities
- Development of the Project Schedule
- Documentation of Relevant Data and Analysis of Requirements
- Development of the System Concept.

This section of the guide addresses these system design and development activities. System implementation activities are the subject of Section III.

2.1 FORMATION OF AN ORGANIZATION FOR MANAGEMENT OF SYSTEM DESIGN ACTIVITIES

This section assumes that a number of agencies or governmental departments will be served by the new system, and each should therefore play some role in its definition, design, and implementation. Other high technology projects for individual agencies or departments will be able to omit some of the activities related to the committee approach to project management.

The community must first create a committee or management organization which has the authority and responsibility

(as well as established procedures) to enable the development of a system concept; a system concept which will be mutually acceptable to the potential users. Although this planning/management organization will vary in size according to the size of the project, the establishment of an effective planning organization will require a clear definition of authority, responsibilities, and commitments of each participating agency and planning group member. A typical organization for a system design project is shown in Exhibit II-1.

The three most important accivites related to the formation of the planning and management organization are:

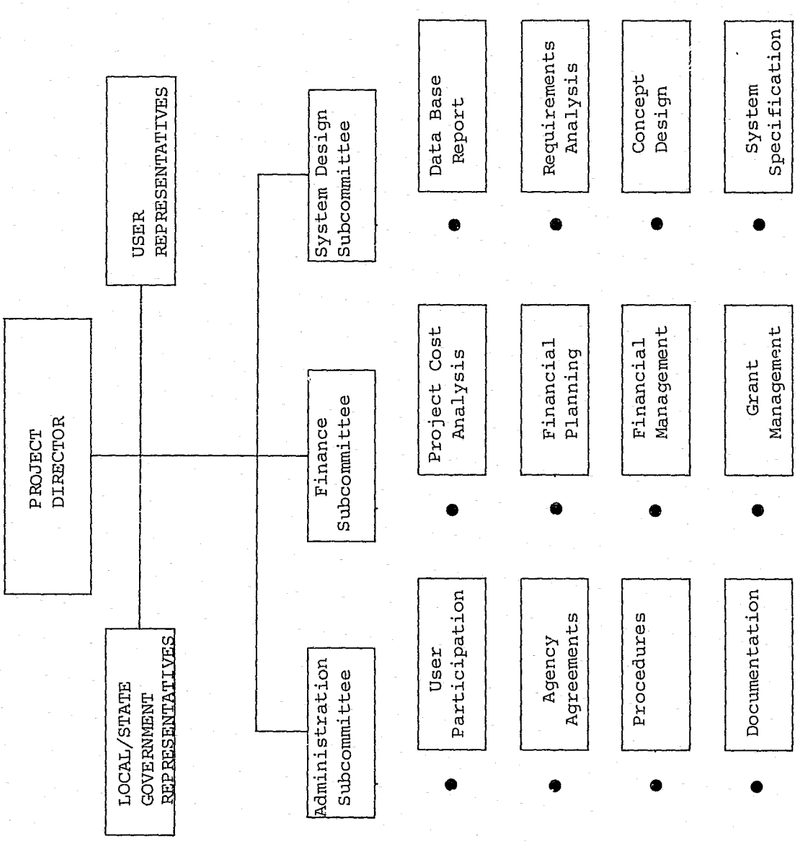
- Documentation of agreements among participating agencies or departments
- Definition of authority and responsibilities of participants
- Establishing ground rules for changes in agreements, responsibilities and project schedules.

2.1.1 Documentation of Agency Agreements

The participation of each potential user of the system in the planning, implementation, and operation of the proposed system should be clearly defined and understood by all other participants. This can be accomplished by written and signed agreements with each agency. Each agreement should identify the following as a minimum:

- Services to be provided to the agency by the system
- Support to be provided by the agency for the planning, implementation, and operation of the proposed system
- Facilities, and/or equipment the agency is obligated to provide to the system including the disposition of the facilities and/or equipment if the agency withdraws from the program
- Funding and/or cost-sharing agreements the agency is obligated to provide to the system

EXHIBIT II-1
Typical System Design Project Organization



- The conditions under which the agreement can be modified or terminated

- Disposition of equipment being replaced by new system equipment

- Agreement relative to the authority of the Project Director.

These agency agreements are the basis for the participation of each agency. When endorsed by higher authority, they insure the official continuation of agency participation and limit the liability of each agency to the specified obligation.

2.1.2 Definition of Authority and Responsibilities of Participants

The complexity of the project management structure will be determined by the size of the project. The size of the management organization for the system development planning should be held to a minimum consistent with the needs of the participating agencies. The authority and responsibilities of each component of the planning organization should be clearly defined and documented.

In every project there should be one person designated as the Project Director with overall authority for the planning program. This authority will be vested in the Project Director by agreement with the participating agencies and must be clearly defined in each Agency Agreement. In the case of a management committee, where members have voting authority on project issues, the Project Director shall act as the Chairperson of the committee or should at least be in the position to cast the tie-breaking vote.

The agreement and documentation of project planning authority should include at least the following organization elements:

- Project Director - the authority to manage all elements of the project planning organization and to release all reports and orders related to the progress of the project and matters of implementation and operations of the proposed system

- Participating Agencies - the scope of authority assigned to each participating agency relative to elements of planning and documenting the system

- Planning and Implementation Groups/Sub-committees - the purpose and scope of each working group or sub-committee should be documented including the scope of authority each has over its assigned task

- Agency Representatives - each participating agency should have one or more personnel assigned to coordinate between the agency and the project organization. The authority of each such person should be agreed upon and documented.

The authority vested in each participant and participating group must be in accord with the individual scope of responsibility. Responsibility for project performance must be clearly defined and documented for each participant. The responsibilities of the management organization must address the system development activities needed to achieve a reasonable system concept, one that will meet the system needs as perceived by the participating agencies. However, responsibilites of the initial planning organization need not include the functions of implementing the system concept if the initial planning organization is not intended to carry over to system implementation.

The specific delineation of responsibility for each participant will vary with the size of the project and system complexity. Areas of responsiblity that are fundamental and will apply to all projects include the following:

- Planning Responsibilities - the specific planning responsibilities of the Project Director, the participating agencies, the project group, and project committees must be defined and documented; responsibilities must also include conformance to the project schedule. As a minimum, specific planning responsibilities will include development of the project schedule, documentation of data and analysis of requirements, development of the system concept and acceptance or approval of the system concept.

- Funding Responsibilities - the funding responsibilities for system development activites will most probably be borne by local agencies and the participants. Funding responsibilities and the means by which they are expected to be discharged by each agency will require negotiation. These funding agreements must be clearly documented. Adequate funding must be identified to cover the following typical expenses:

  - Paid time for project participants
  - Travel/subsistence expenses
  - Clerical support and report preparation; effort related to data collection, documentation, and analysis; effort related to development of the system concept
  - Outside assistance in analysis and design activities.

- Schedule Compliance - the project schedule for system development activities will be the result of a joint agreement among the project participants. Each agency will be responsible for complying with their assigned functions within the overall project schedule. The Project Director will be responsible for documenting the project schedule, measuring schedule compliance, reporting on schedule performance, and initiating any needed schedule revisions.

Each project organization will develop the additional scope of detail of individual responsibilites that is required in order to meet the needs of the specific project complexities. These will vary in accordance with the objectives and goals of individual projects and tasks.

2.1.3 Ground Rules for Changes in Agreements, Responsibilities, and Project Schedules

Changes in planned system development activities must be accommodated in the planning process. These changes will typically be experienced as the project matures. A well-documented planning organization will require change procedures that must be coordinated with the original documentation. A decision will be required as to the level of

changes that will require document revision and the level of changes that will not. In general, changes in agreements and agreement documents that affect active participation in the program and changes in the program schedule will require change notification. Specific areas of changes that require documentation and should be reported will include the following:

- Participation - any change in the Agency Agreements
- Authority and Responsibility - any changes in the scope of authority and/or responsibility of any participant or changes in the assignment of authority and responsibility
- Agency Representative - changes in the designated representative of the participating agencies
- Schedules - any changes in the project schedules and/or the ability of any participant to meet schedule commitments.

As an early planning effort, the Project Director must establish the mechanism for documenting project changes and how these changes are to be reported in a timely manner. Changes which require formal review and approval by the participating agencies and those which may be implemented by the authority of the Project Director should be clearly defined.

2.2. DEVELOPMENT OF THE PROJECT SCHEDULE

Effective project management requires realistic scheduling, monitoring, and reporting. The early development of a master project schedule of events and milestones will be needed to guide the planning program through the development of an acceptable system concept. The major elements of project scheduling are discussed in the following paragraphs.

2.2.1 Type of Project Schedule Chart

The project schedule should be displayed on a graphic time-dependent chart which shows each major task with scheduled start date, a scheduled completion date, and with intermediate milestones for evaluating progress. The chart will be supported by the narrative descriptions of the tasks, their milestones, and final products as appropriate.

The complexity of the project should determine the type of schedule chart to be used as well as the detail required. Examples of basic schedule charts are shown in Exhibits II-2 and II-3. The least complex should be selected compatible with the needs of project management and the ability of the participants to make effective use of the chart. Basic chart forms appropriate to the system development process include the following:

- Gantt Chart - the traditional and most basic of the time-dependent bar charts; useful for the less complex programs with more obvious interdependent task relationships

- Milestone Charts - an expansion of the basic Gantt type chart to include planned milestones and reporting points for each task. This is the most widely used and easily interpreted of the chart forms. Funding milestones are typically used when costs related to each task are critical in program planning. This easily interpreted chart form is frequently used for programs in which there is incremental funding

- Network Charts - network charting techniques such as CPM (Critical Path Method) and PERT are suitable for programs which include numerous interdependent tasks. Because of their complexity, these chart forms are seldom used for planning programs, but can be particularly useful for complex, detailed implementation plans.

The master schedule chart for the program can also be supported by subordinate schedule charts for individual tasks. These subordinate charts can provide a deeper level of planning detail than would be appropriate for the master schedule chart.

The master schedule chart will include intermediate milestones for project review and schedule revision. A greater level of detail in the master schedule will frequently be added as the program matures. The milestones for periodic program evaluation and for revising the master schedule to accommodate changes must also be included in the initial program plan and project schedule chart.

EXHIBIT II-2
Project Schedule Chart Forms

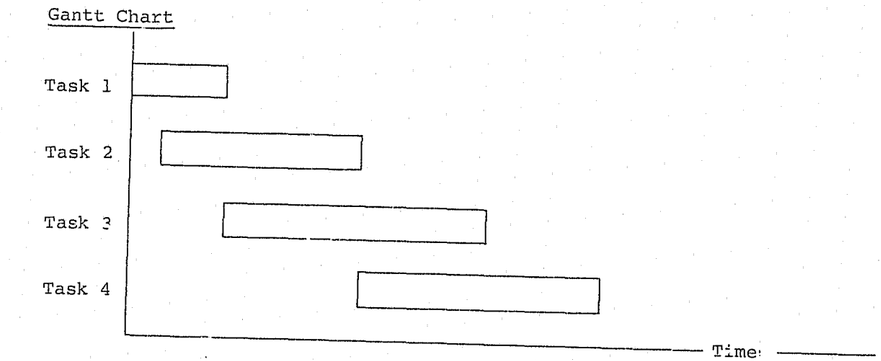
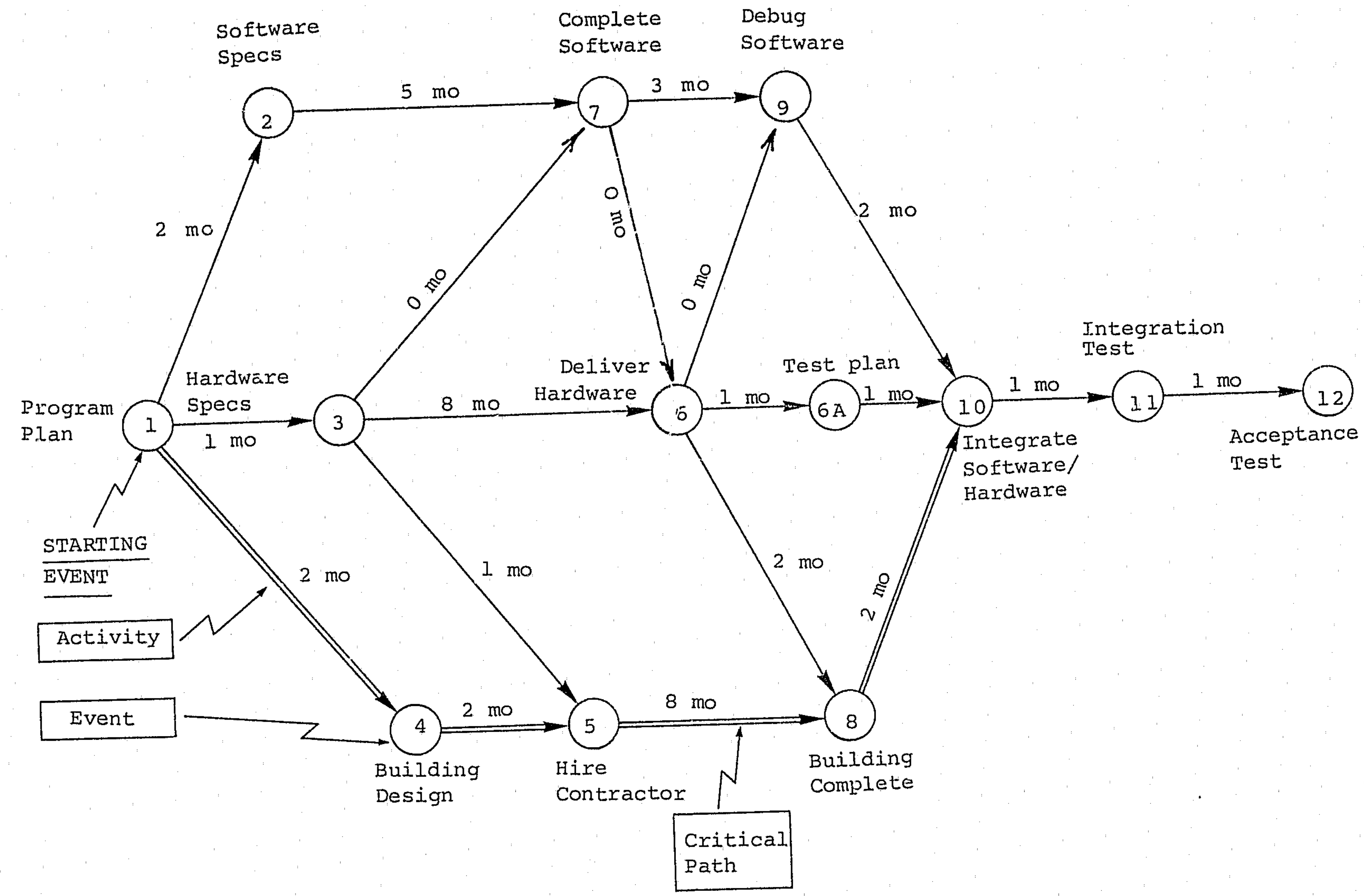


EXHIBIT II-3
Sample Pert (or CPM) Network



When properly constructed, the master project schedule is used to manage the progress of the program, make corrections in the scheduled completion of supporting tasks, make timely reports of progress to the participating agencies, and make substantive project reports to higher authority.

2.2.2 Activities and Milestones to be Included on the Master Project Schedule

The project schedule provides a graphic display of the time-dependent, inter-related tasks that together define the project from its inception through system design and eventually through procurement, implementation, and system evaluation. It will also display the time-related milestones and reporting points for each task, thereby affording management control over the progress of the project.

The level of detail required of this master schedule and its supporting narrative will be determined by the complexity of the program and the number of participating agencies. Tasks, events, and milestones should be included if their completion can be identified by physical evidence such as the delivery of a report. The completion of a milestone, event, or task should clearly advance the project toward its final objective.

The following paragraphs discuss some of the activities and milestones that are basic to the master project schedule. Expansion beyond these basic elements will be necessary in order to reflect the unique needs of specific programs.

2.2.2.1 Formation of the Project Management Organization

The initial activities on the project schedule are related to the establishment of the project management organization. It seems reasonable to assume that the user agencies have mutually explored their technical options and have turned to the trunked radio technology as the probable solution to their communications problems. This degree of mutual activity implies that an organization of some type, formal or informal, already exists at the inception of this program. The first task is to document the existing organization form and build upon it to create an effective project management organization.

The detail of this organization development will vary with the size and complexity of each project. Some of the

activities related to organization of the project team that will apply to most projects are:

- Setting up the Project Team - time needed for developing the structure of the project team should be scheduled. The time allocated to this activity should be limited unless there is a need for formal approval, such as the passing of resolutions or orders by a governmental body

- Definition of Authority and Responsibility - the time needed for the formal documentation of the authority and responsibility of the members of the project team and their standing committees must be scheduled. The time allocated to this task should be also limited unless formal approval is required

- Documentation of Agency Agreements - time must be scheduled realistically to secure documented agreements from the individual agencies who plan to participate in the program. The contents and form of such agreements are suggested in Appendix A and these formal documents will usually require review and approval by the respective governmental bodies. The time allocated in the master schedule for the acquisition of these agreements must be reasonable, but not so long as to jeopardize the timely initiation of system development activities. Agencies can be added to or subtracted from the project during its life, and it is not necessary that all agreements be executed before system development activities can be started.

These organizational matters should be underway before the tasks related to system development are scheduled to start.

2.2.2.2 System Design

System concept design is the next major task to be delineated in the master program schedule. The time allocated to system development is a direct function of the size of the proposal system in terms of the number of agencies to be served and the technical complexity of the proposed system. The level of detail, as indicated by specific activities under the system development heading, will be determined by the unique needs of each specific system environment and can be expanded as the program matures.

All system planners will need to schedule the planning tasks needed to identify the existing telecommunication assets that can or must be used in the new system. The planners must also document the functional telecommunication needs and desires of each participating agency, develop the consolidated functional requirements of the new system, and develop an approved system concept. These basic elements of system development scheduling are discussed in the following paragraphs.

- Data Acquisition - the master schedule must provide a reasonable time to acquire and document the needed system data from the participating agencies. This data will include the complete description of each communication system as it is presently configured, the facilities (dispatch centers, towers, personnel, etc.) each agency has assigned to its communication operation, the functions each agency requires of its communications systems, and the additional functions each agency believes it needs from an improved communication system. Channel load information, (i.e., peak load hours) may also be appropriate to the project requirements. In some cases, the functional capability of the equipment items, the type of equipment and its age will need to be documented. The data must also include anticipated changes to accommodate needed system growth. The methods and procedures for acquiring these data are discussed in Appendix B. The scheduled time allocated to this task will vary as a function of the number of agencies surveyed and the relative complexity of their existing communication systems. Time must also be scheduled for the verification of the data once it is documented. This task element is critical to the integrity of the concept design. The planners will schedule sufficient time for its completion keeping in mind that the subsequent task elements can usually be started before final verification of this data base.

- Consolidation of System Functional Requirements - the time planned for the development of consolidated functions to be provided by the new system can begin before the final verification of the data base. Each agency will have indicated which of the communication functions are needed and

which communications problems are to be solved by the proposed system design. Time must be scheduled for the project team to resolve conflicts between these requirements and to obtain verification and approval from the participating agencies. Adequate time must also be scheduled for review and approval of system functional requirements. The proposed set of functions for the new system must also be scheduled for review and approval.

- Development of the System Concept - the time schedule for the development of the system concept must allow for adequate review by the participating agencies and subsequent revision by the project team. This is the last task element of the system development activities. The approved system concept document will be the basis for subsequent system implementation. Time must be scheduled for adequate review by governmental bodies and for presentations to review committees and/or funding organizations.

It is evident that the complete accuracy of an implementation schedule conceived at an early stage of program planning is not critical. However, the schedule is driven by critical time-dependent elements such as the lead times needed to gain approvals and/or funding and these must be fitted into the Master Project Schedule at an early date if timely completion of the project is to be achieved. Some of the more critical elements that will appear in the initial implementation schedule include the following:

- Implementation Management - the development of the implementation management organization, its operational procedures and funding plans.

- Reporting Schedules - the detailed implementation plan must include appropriate reporting milestones for management control.

- Procurement Documentation - a schedule must be established for the preparation and approval of an effective competitive procurement package; the procurement may require two-step documentation in which a Request for Proposals is solicited prior to the preparation of the system specification and the preparation of a Request for Bid.

- Solicitation of Bids - adequate time must be scheduled so that prospective bidders will be able to familiarize themselves with the project requirements and thereby offer a more comprehensive bid and proposal; the complexity of the project may require the solicitation of technical proposals from prospective bidders prior to the solicitation of bids (a two-step procurement).

2.2.2.3 General Implementation Schedule

Upon approval of the system concept the program is ready to enter the implementation phase. Although implementation may not be recognized as being within the scope of system development as defined in these guidelines, the master project schedule will usually include the task elements of implementation and post-implementation evaluation so that all key elements of a complete plan are included in the program schedule. It is recognized that these two later groups of task elements may become the responsibility of another project team, and that considerable detail will need to be added to this portion of the project schedule as the project actually enters the implementation phase.

- Contract Award - higher technology projects require adequate time for the careful structuring of the contracts to provide the materials and services that are required.

- Facility Preparation - renovation of existing property or the construction of new buildings is an expensive and time-consuming necessity that must be scheduled as a part of the implementation program as needs become known.

- Equipment Installation - the successful bidder will define the time periods during which the equipment will be installed and checked out. However, the time schedule for this activity must be recognized in the earliest of the implementation master schedules.

- Personnel - the acquisition of the personnel required to operate and maintain a sophisticated system must be coordinated with the system implementation schedule if timely delivery is to be achieved.

- Training - proper training of operating and maintenance personnel is extremely important; adequate time must be scheduled in the implementation plan and coordinated schedules.

- Test and Cut-over - the series of implementation tests associated with equipment delivery should be included in the initial master scheduled and modified as more timely information becomes known and the scheduled cut-over time is approached.

- Acceptance - the master schedule should allow a reasonable time for acceptance inspections and test to be conducted before cut-over time.

- Documentation and Reports - throughout the implementation schedule, progress reports and deliverable documents such as manuals and drawings should be scheduled to enable management and control of the progress of the project.

2.2.2.4 Schedule for New System Evaluation

The post-implementation evaluation of a recently installed system begins with the acceptance test and proceeds at regularly scheduled intervals thereafter. The evaluation task that is made part of the Master Project Schedule consists of these time-dependent activities:

- Evaluation Criteria - the time scheduled to review system performance measures and select those elements which will be critical to demonstrate the new system response to project goals and objectives

- Data Acquisition - the scheduling of periodic measurements of system performance with respect to the evaluation criteria

- Data Evaluation - the schedule time needed to evaluate the periodic measurements of system performance and prepare an evaluation report based on the system evaluation criteria.

2.3 DOCUMENTATION OF DATA AND ANALYSIS OF REQUIREMENTS

The first major task directly related to the development of the system concept involves the documentation of current systems and the requirements of user agencies.

The development of an appropriate system concept and the implementation of that concept requires a clear understanding of the underlying needs and requirements of the potential users. This understanding of requirements depends upon the documentation of the currently used systems, their facilities, their operating procedures, equipment and other assets which could affect the new system design or planned growth. It is a reasonable approach to consider the new concept design as one which retains all of the desirable procedures and practices of the existing systems and adds to these the special advantages of the new system.

The activities related to the acquisition of this data, its documentation and verification and the use of this data in the design of the new system are discussed in the following paragraphs.

2.3.1 Data Acquisition

The methods of data acquisition that are adequate for the purpose of concept development and system design are discussed in detail in Appendix B. The development of a well-designed data collection program is critical to the project.

It is important that the specific needs of the project be reviewed and that the kinds of data required be identified. Only required data should be collected and only from those sources which can provide accurate data. It is not necessary or advisable to collect and assimilate all available data related to the users systems or procedures without concern as to its relevance to the solution of the system problems at hand. The specific scope of data acquisition and the procedure to be used for data collections will be unique to the needs of each project.

To the greatest degree possible existing documents and records should be reviewed as an initial source of the needed data. These documents should include, but not be limited to, the following:

- Licenses: FCC license records in particular are a source of valuable information

- Inventory Records: Computerized inventories will identify available assets that can be appropriate to the new system design

- Maintenance Records: Details of existing equipment performance are frequently available from maintenance and repair documents

- Financial Records: The cost of owning and operating the existing system can be of value in the analysis of new system concepts.

The needed data not available for documentation review can be acquired through interviews with selected personnel.

2.3.2 Interviews and Documentation of Results

Although the interviews needed for data acquisition should be informal, the conduct of the interviews should be structured. The interviews must be planned in advance to yield the maximum of needed information in the minimum of time.

It is appropriate to schedule the interviews in advance and to inform the interviewee of the kinds of information that will be requested. This can be done by a letter of introduction or, less formally, by an earlier telephone call. If a preprinted questionnaire is not used to organize the interview, then a standard interview guide should be used to structure the interview in a topical manner and to record the responses to each of the areas of inquiry. These areas would include the following major topics:

- Current Systems: Identify the procedures and facilities of the existing systems that would affect the concept design for the new system.

- Current Equipment: The equipment that is to be salvaged or disposed of should be identified; the age of equipment may be needed to document salvage or disposition value.

- Current Problems: The identity of problem areas with the present system which should be corrected by the new system.

- Functional Requirements: The description of how the systems must function in terms of operation requirements, interfaces, and effectiveness which should be retained or improved upon by the new system.

- Operating Costs: The annual recurring costs for operating, maintaining, and staffing the current system.

- Anticipated Improvements: The documentation of the changes and improvements the users will expect or demand of the new system.

The results of the interviews should be summarized and reported on a standard form so that the interview data from several sources can be compared directly.

2.3.3 Verification of Data

Data will have been acquired from document reviews and from interview records. There will probably be differences among the various sources of data and these differences must be reconciled.

The interview guide, if properly planned, can also be used as an instrument for resolving data conflicts. The collation of data from the various independent sources can be used to complete a data form (alternatively a survey questionnaire) for each of the potential user agencies. These completed forms can be submitted for individual review by each of the agencies. Any corrections or variations can be noted. The final data form will then represent each user agency in the terms that they themselves have accepted.

2.3.4 System Requirements Definition

The verified data acquired from the proposed user agencies will include the definition of problems each is having with the existing systems, the functional requirements each demands of the telecommunication systems, and from the new system. The consolidation of these individual inputs will provide the basis for defining the preferred system requirements for the new system.

2.3.5 Problem Analysis and Solutions

The system problems to be addressed will arise from two general sources: the system requirements which may be difficult to satisfy, even with the design of a new system; and the problems that arise from conflicts between the needs of different participating agencies as disclosed by the collation of the data. The analysis of these problems will often require advanced technical skill in addition to project management skill.

Active participation of the major user agencies in the task of problem analysis and solution should be encouraged. Specialists from outside of the user agency group may also be needed. These might include:

- Telecommunications Engineering
- Public Financial Management Specialists
- Equipment Vendor Representatives
- Telephone Company Engineering Specialists.

This activity, which will lead to the definition of the new system concept, must be placed within the direct responsibility of the Project Director. The group of user representatives that must deliberate these problems and their solutions must represent the best technical and management skills available from the user organizations.

2.3.6 Document the Preferred Solutions

A technical and management report is required as an output from the task of problem analysis and development of solutions. A draft of this report distributed to the potential users of the proposed new system and to others will permit all parties to review the range of major problems the new system will address, review the preferred solutions to these problems, and review the scope of alternative solutions that were considered. The final report should include all additions and revisions agreed to by the participating agencies. A well-documented final report will aid in achieving the continued support of the user agencies and other future potential participants in any later discussion of the system concept.

2.3.7 System Performance Evaluation

During the acquisition of the data on current systems, information should also be acquired regarding system performance. Effective post-implementation evaluation of the new system will require baseline data for comparison.

The definition of the type of data to acquire for this purpose will probably be unique with each system implementation. The present users of the system are the better judges of the kinds of measurement and parameters which best indicate the system performance in response to their needs. This information should be collated and compared with the

engineering evaluation of the expected performance of the new system. These data should be documented and retained for later use in the planning of the post-implementation support program. Examples of data forms that may be useful for limited types of post-implementation evaluation are shown in Exhibits II-4 and II-5.

* * * *

The conclusion of each activity described above is needed to support the development of the detailed concept for the new system.

2.4 DEVELOPMENT OF THE SYSTEM CONCEPT

The development of the system concept follows from the analysis of system problems and the development of preferred solutions to those problems. It also responds to the functional requirements for system operation as defined by the user agencies. It should accommodate, to the degree possible, the anticipated improvements in their systems as expressed by the user organization during the interview process.

The required elements of the system concept are:

- System Configuration
- System Operation
- System Description
- External Interfaces
- Required Facilities/Real Estate
- Personnel and Management Requirements
- New Procedures or Regulations
- Funding Requirements.

Each of these elements is discussed in the following paragraphs.

2.4.1 System Configuration

The configuration of the system and its interfaces must be responsive to the solutions to the problem areas and to the functional requirements that were previously defined and

EXHIBIT II-4
Radio Coverage Data

Agency_____Date_____19__Frequency_____MHz

Test Equipment:

Wattmeter: Make_____Model_____Ser. No._____
Signal Gen: Make_____Model_____Ser. No._____
Test Monitor: Make_____Model_____Ser. No._____

Receiver: Make_____Model_____Ser. No._____

Attach calibration curve for receiver (Test reading vs μv input)

Transmitter: Output_____Watts, Line Loss_____db

Antenna Gain_____db, Antenna Directivity _____ True
(Attach antenna horizontal pattern), ERP_____ Watts

Location	Time	Signal Quality	Test Reading	Received μ volts

EXHIBIT II-5
Traffic Load Summation

Agency:_____ Date_____19__

Reported by:_____

Title:_____

	First Shift	Second Shift	Third Shift	Fourth Shift
Peak No. Calls-per-hour				
Average No. Calls-per-hour				
Average Hold Time per Call				
Call Priority				
No. Emergency Calls				
No. Urgent Calls				
No. Routine Calls				
Average Incident Times (sec)				
From Report to Dispatch				
From Dispatch to Arrival				
From Arrival to Close				

documented. The development of a system configuration and its supporting system diagram is an interactive process which should be reviewed and revised until an optimum system concept is achieved.

The system design considerations may be in part unique to each system design but will include the follcwing as a minimum:

- Radio Propagation: Evaluate and document the coverage of the primary service area of the new system at its proposed operating frequency(s).

- Interagency Coordination: Develop the communication methods between the participating user agencies and their supporting agencies

- Channel Loading: Determine the anticipated traffic loads for all communication channels in the system (wire, radio, microwave) as a function of time of day and day of week.

- Command and Control Subsystem: Document the number and location of control points for the system and define the responsibility of each control point.

- Citizen Access: Develop the means of prompt citizen access to those user agencies in the system who provide an emergency response (i.e., police, fire, ambulance services).

- Data Systems: The data systems can be internal to the system configuration (Computer-Aided Dispatch, Mobile Data Terminals) or external to the system (Motor Vehicle Department, National Crime Information Center, National Law Enforcement Teletypewriter Service, etc.); each having its own technical requirements and interface requirements with the command and control functions.

- System Reliability: Define the reliability requirements for each system element; develop the level or redundance and maintainability needed to achieve the desired level of reliability.

- System Management: The system design configuration should accommodate the system management structure meeded to supervise system performance.

These elements and others unique to the specific system under development will be the principal factors that determine the system configuration. It is preferred that this system configuration be described graphically in a system diagram supported by written documentation.

The system configuration should be developed by a group of user representatives under the guidance of the Project Director. The authority of that group to obtain the approval of the user organizations and to decide on the system configuration should be clearly documented.

2.4.2 System Operation

A document that defines the operation of the system as defined by the system configuration should be prepared. This document can be developed along with the system configuration and can be part of the supporting document that describes the system diagram.

All of the procedures for command and control from each control point should be described. The operation and limitations of each system interface link should be defined. These will include the interagency communication links, the data system links, citizen access, and other links to support services. Routine operation of the system and also operation under emergency conditions should be included.

The planning group should also consider the operation of the system in a degraded mode in which one or more of the system facilities is inoperative or partially inoperative. These evaluations should be reflected back into the system configuration to be certain that the loss of a single element will not be catastrophic to system performance.

The system operation description will later be part of the procurement documentation. It will also be basic to the later development of an operator's manual.

2.4.3 System Description

The delineation of the system configuration and the detailed description of its operation are preface to the preparation of the system description. This document provides the means by which competent judgments can be made regarding the need for physical facilities such as buildings or towers, the need for public utility services such as telephone or power, and the need for independent support services. These in turn enable the development of cost

estimates for the new system as needed to initiate the funding plans.

The system description should be developed in sufficient detail to be included in the procurement documentation as part of the system specifications. Major elements of the system description are discussed below:

- Performance Requirements - The technical performance requirements for all functional elements of the new system should be defined. The technical detail should be limited to the performance of the element and the range of allowable tolerance in performing the function. The technical detail need not define how each element is to perform its required function; this level of detail is best left to the equipment specifications which are part of the procurement documentation.

- Interfaces - The internal and external system interfaces must be defined. The technical detail should be adequate for personnel skilled in each of these subsystem technologies to recognize the system engineering procedures that must be followed in meeting the system interface requirements.

- Control Functions - The system description must define all control functions and command/control facilities to be available at every system control point. The number of control points should be minimized. The identity of control links (telephone, microwave) and any technical interface restrictions they have (control tones, line levels, supervisory signaling, etc.) should be defined. Signaling, supervisory functions, filters, switching functions, hot standby capabilities, cross patching, and other features developed from the system operation description should be fully described.

- Radio Frequencies - The system description should include all of the radio frequency assignments. These include the RF frequencies of each channel and any control tones or Continuous Tone-Controlled Squelch System (CTCSS) frequencies used. The frequency of microwave links and their pilot tones or control tones should be described. The radio

frequencies of an interfacing subsystem such as civil defense or EMS should be included as appropriate. Caution should be exercised in the assignment of radio frequencies which are subject to FCC licensing (see para. 3.3). There should be substantial evidence in the form of an existing license or valid frequency coordination that show the indicated frequencies as being available for licensing to the system.

- Privacy of Information - Pulic safety or criminal justice information is not freely available to the public; Federal and State laws protect this information. If the new system includes data terminals that access these data systems, electronic and physical security must be provided. Specially cleared operators having unique data system password codes should access only those data terminals permitted to receive these data. The communication center containing these terminals must be secure against all but authorized personnel. Transmitting this data by voice radio circuits may also require secure digital voice transmission. The system description must include the technical characteristics of each of these provisions.

- Consolidated Facility Security - The system description should include the provisions made for the physical security of the consolidated facilities. Remote transmitter or receiving sites can be provided with intrusion alarm systems in addition to the physical protection of the site against damage by fire or theft. The Control Centers should be protected from public access; only authorized duty personnel should be provided access to the control points and dispatch centers. The technical characteristics and interface requirements for these security subsystems should be defined.

- Reliability/Maintainability - The system description should include requirements for system and subsystem reliability in terms of mean-time-between-failures (MTBF) and mean-time-to-repair (MTTR). If greater reliability is needed than that obtainable from simple system configurations, redundancy of critical equipment functions and a higher level of maintability should be included in the system configuration.

Ancillary Items - The system description should also define the technical parameters and functions of ancillary equipments and subsystems needed for system operation. These might include, for example:

- Conveyor systems for dispatch cards
- Emergency power generator systems
- Teletype for the deaf and handicapped
- Fire protection and fire suppression systems
- Key punch and data reduction equipment
- Interior intercom equipment
- Personnel staff facilities (lockers, showers, etc.)

Included in ancillary items are any items of special tools and test equipment, spare modules, and spare parts needed to maintain the equipment to the level of reliability desired. This may require a complete review of maintenance policies and procedures, particularly if maintenance has been one of the problem areas defined in the data acquisition program.

In each item discussed above, it is understood that all of the parameters and characteristics of the described subsystems may not be fully known or realized at this point in the planning program. However, it is sufficient at this point to develop the system description limited to the level needed for planning purposes. Those areas which will need further definition for final system development will be noted. It is also evident that as the project matures to the procurement stage, the user organizations and the potential suppliers of the system and its equipment will further refine the definition of functions and characteristics. The final system description that will be part of the procurement contract will reflect some of these modifications and, as a result, may differ in significant ways from the initial system concept.

2.4.4 External Interfaces

The system concept will include the technical characteristics and limitations imposed by the needed interfaces with supporting systems external to the new communication system. Many of these will require technical inputs from specialized personnel from outside of the user groups. Some of the external systems include the following:

- Telephone Systems: Telephone system engineering assistance is available from outside consultants and from the operating telephone company. The use of technical specialists is particularly recommended if special telephone systems such as 911 are to be specified as part of the system concept.
- Data Information Systems: The interface with established data systems such as Criminal Justice Information Systems (CJIS), National Crime Information Center (NCIC), and Management Information Systems (MIS) have restrictions and protocols which must be observed.
- Interactive Data Systems: Interactive data systems such as Computer-Aided Dispatch (CAD) or Mobile data Terminal (MDT) installations require specialized technical services to correctly define their functions and technical characteristics as part of the system description. Because they are interactive, the interface requirements may appear to be more critical than the conventional data information system interfaces.

2.4.5 Required Facilities/Real Estate

The system concept must define the physical facilities required by the new system. During the acquisition of data and the analysis of system problems, the location and characteristics of available physical property in terms of buildings, real estate, towers, and other assets usable in the new system were identified. The system concept will make the maximum use of these properties, modify them, or add to them as necessary.

Specifically, the system concept will define the following:

- Dispatch Centers: The required dispatch centers will be identified and required changes in layout or staff facilities will be indicated.

- Buildings: The architecture of new buildings or changes to existing buildings must be noted; transmitter buildings, equipment buildings and staff accommodations are included.

- Real Estate: Any additional real estate for new construction will be identified.

- Towers: Modifications to existing towers and tower sites or the need for towers and new tower sites must be defined in technical and descriptive terms.

- Utilities: The need for power, water, telephone or other public utility services to any of the new or modified fixed sites in the new system must be defined in technical and descriptive terms.

- Environmental Impact: If any modification to an existing facility or the erection of any proposed new facility such as a building or a tower requires an environmental assessment under Federal or State regulations, this will be noted in the system concept document.

- Licenses and Approvals: Modification to towers and the erection of new antenna support structures may require FAA engineering approval before work can begin or before FCC licenses can be awarded. The system concept will identify these requirements as part of the system configuration.

2.4.6 Personnel/Management Requirements

A major element of cost for any system is labor and management. The system concept will address the specific need for personnel to implement, operate, and manage the new system.

- Personnel Staffing - A public safety communications system is operated 24 hours a day, 7 days a week. Personnel requirements for manning the system will have a major impact on the estimated cost for operation of the system. The system concept must therefore include an estimate of the operations personnel requirements. (One effective means of obtaining adequate estimates is to develop draft manning tables which define the required number of personnel on duty and the number of work positions active on each shift of each day. These are determined by traffic load studies and work load studies conducted after the basic system configuration has been established.)

- Training - The system concept must identify requirements for the training of operating personnel and maintenance personnel for the new system. The required training facilities should include those training modules which are particularly important if an interactive data system such as CAD is to be included.

- Management Organization - The organization to manage the new system should be clearly identified. Its authority and responsibility should be defined as part of the system concept. The physical facilities for locating this management and supervisory function near the operating staff should be included among the required facilities identified in the system concept.

The definition of the personnel structure and management organization can be vital to the acceptance of the new system by the user group. The system concept should be concise in this regard.

2.4.7 New Procedures or Regulations

Implementing the system concept may require changes in existing procedures and policies or changes in some rules and regulations. The system concept should include any of those changes that the planning system has shown to be a potential issue. Some of the more probable changes include the following:

- Operating Procedures: The interagency coordination plan may require the standardization of operating procedures among the user agencies.

- Job Descriptions: If consolidation takes place, this consolidation of the communication functions may require changes in the job descriptions of communications personnel and the development of new salary structures.

- Job Qualifications: An advanced order of training will be required for all personnel, particularly the maintenance technicians, and a more rigorous job qualification testing program may be needed.

- Jurisdiction: The operation of the new system could cross recognized jurisdictional boundaries; resolutions or ordinances may be needed for legal clarification.

The system concept should include provision for any of these changes found to be needed as a result of the reviews and discussions by the user organization during the system concept deliberations.

2.4.8 Funding Requirements

The system concept will include cost estimates for each element of the new system. These cost estimates will be based upon the best cost information that is available at the time the system concept is completed. This cost estimate must include the estimated costs for all goods and services required for implementation and operation of the new system. It is expected that some time will pass between the presentation of the proposed system for funding approval and the final acceptance and operation of the completed system. The cost estimates must be adjusted for cost escalation during that period of time. Factors relative to the incremental scheduling of these funds are discussed in para. 3.2.2 on page III-8. During the implementation program, financial milestones will be a critical factor in the success of the program and must be scheduled as project milestones.

The funding required can be categorized as non-recurring costs and recurring costs.

2.4.8.1 Non-recurring Costs

These one-time costs are related to the acquisition and installation of the equipment, services, and the facilities needed to implement the system. These will generally include the initial costs for the following:

- Hardware: The initial purchase price of all equipment, tools, and test equipment. The initial cost of spare parts and assemblies is also included.

- Professional Services: These include legal fees, engineering fees, and also costs for consultants or architects.

- Installation and Test: The cost of installing the hardware/software and preparing it for acceptance. The cost also includes the installation of telephone, power, water, and sewer services.

- Facility Preparation: The cost of building renovation, preparing land, etc.

- Training: The initial training of start-up personnel and the initial acquisition cost of training programs and training materials.

- Labor: The one-time cost of labor purchased for the preparation of grant requests, duplication of reports, and other labor purchased for the system planning effort.

2.4.8.2 Recurring Costs (Operations/Maintenance)

These costs are those which are billed against the system on a periodic basis after it has been placed in operation. These include the following:

- Personnel: Salary and overhead costs for all personnel assigned to the system operation

- Maintenance: The cost of maintenance and repair of system software and hardware

- Utilities: The periodic billing for telephone, heat, power, water, sewer use, and other public utilities

- Lease/Rent: The cost of leasing or renting property and equipment used in the system

- Supplies: The cost of all expendable supplies used by the system and its management

- Training: The cost of updating present personnel and training replacement personnel

- Equipment Replacement Cost: The annual cost of replacing worn out or obsolete hardware and software properly identified as part of the original system

- Financing: The cost of debt service on short-term borrowing; the cost of insurance or other surety instruments.

These non-recurring and recurring costs should have been introduced into the project during the evaluation of alternative solutions to the problem areas and needs of the new system. It is probable that in the final analysis before the system concept is offered for approval and fundings, the Project Director will consult with financial specialists to verify the estimated cost of these goods and services and to be more certain that adequate provisions have been made for cost escalation.

The source of funds needed for non-recurring and recurring costs should now be considered. The use of these funds may impose restrictions which must be considered in the system design, operation, and management.

Typical sources of funds for non-recurring costs include:

- State grants-in-aid

- Federal grants

- Grants from private foundations

- Bond issues for capital acquisition

- Gifts from private sources.

Typical sources of funds for recurring costs include:

- Users charges

- Taxes

- Shared revenues from State government

- Municipal revenues (fines, interest, fees, etc.).

The user agencies can also defray some non-recurring costs by providing services or facilities that would otherwise be purchased or leased.

* * * * *

In defining the system concept in the detail described in the above paragraphs, it is realized that the best information available must be used. However, as the concept is reviewed and debated, additional information will become known and technological advances may improve the integrity of the system and change the detail of the original concept.

It is advisable that the planners and the Project Director do not attempt to produce a detailed engineering design in the process of developing the system concept. There should be room left for later innovative solutions.

The final system concept should result from recommendations by the principal user organizations and by other agencies affected by the implementation of the proposed system. It is recommended that at least one draft of the proposed system concept be submitted to these agencies for review and comment before the final system concept is made public. Such a review and approval will enhance acceptance of the system and reinforce the effectiveness of the agency representatives who have served with the Project Director.

SECTION III

SYSTEM IMPLEMENTATION ACTIVITIES

III. SYSTEM IMPLEMENTATION ACTIVITIES

A decision to implement the new system concept and prepare for the evaluation of the results achieved will require written commitment of public record which will include:

- Agency Agreements - signed agreements with all participating user agencies will have been obtained and recorded
- Governmental Agreements - resolutions or other legally binding commitments will have been passed by the elected governing bodies of the participating communities
- Funding Agreements - funds will have been committed by local budgets, or by approval of State/ Federal grant requests, to implement the system concept of record.

The important system implementation activities include the assignment of project management authority and responsibility to proceed with the development of the implementation plan; acquisition of and preparation of facilities, equipment and personnel; and post-implementation system evaluation. These system implementation activities are the subject of this section.

3.1 MANAGEMENT

3.1.1 Management of the Implementaton Project

The management and direction of the implementation program should be vested in a program director who is supported by staff and committee assignments. Project management should have overall authority for planning and directing the implementation program. The designated program director must be acceptable to the user organizations and to the participating communities. Commitment to this acceptance should be made part of the agency agreements.

The principal responsibilities of project management include the following:

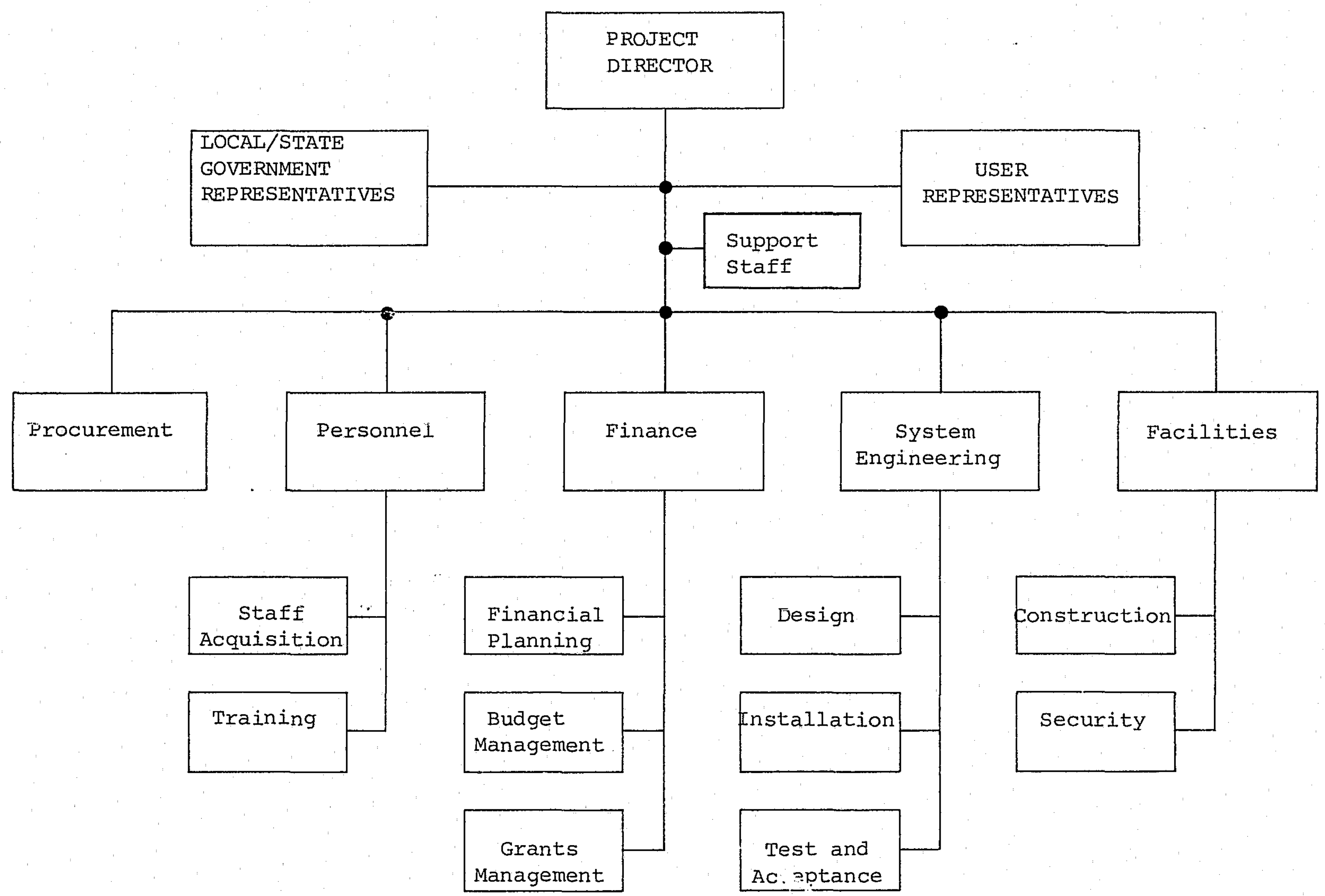


EXHIBIT III-1
Typical Project Management Organization

3.1.2 Development of the Management Plan

An initial activity of the project management group is to develop specific plans for the organization needed to manage the new system and to organize the staff personnel required to operate the new system.

The organization originally proposed for managing the new system operation was included as part of the system concept document. This management concept should now be expanded to identify the number of management positions needed and the specific characteristics of each. This will enable the decision to be reached relative to filling these positions with newly hired personnel or whether these positions might be filled by personnel on assignment from the user agencies or other supporting agencies. A typical system management organization is shown in Exhibit III-2.

Some of the elements to consider include those in the following paragraphs.

3.1.2.1 Administrative Requirements

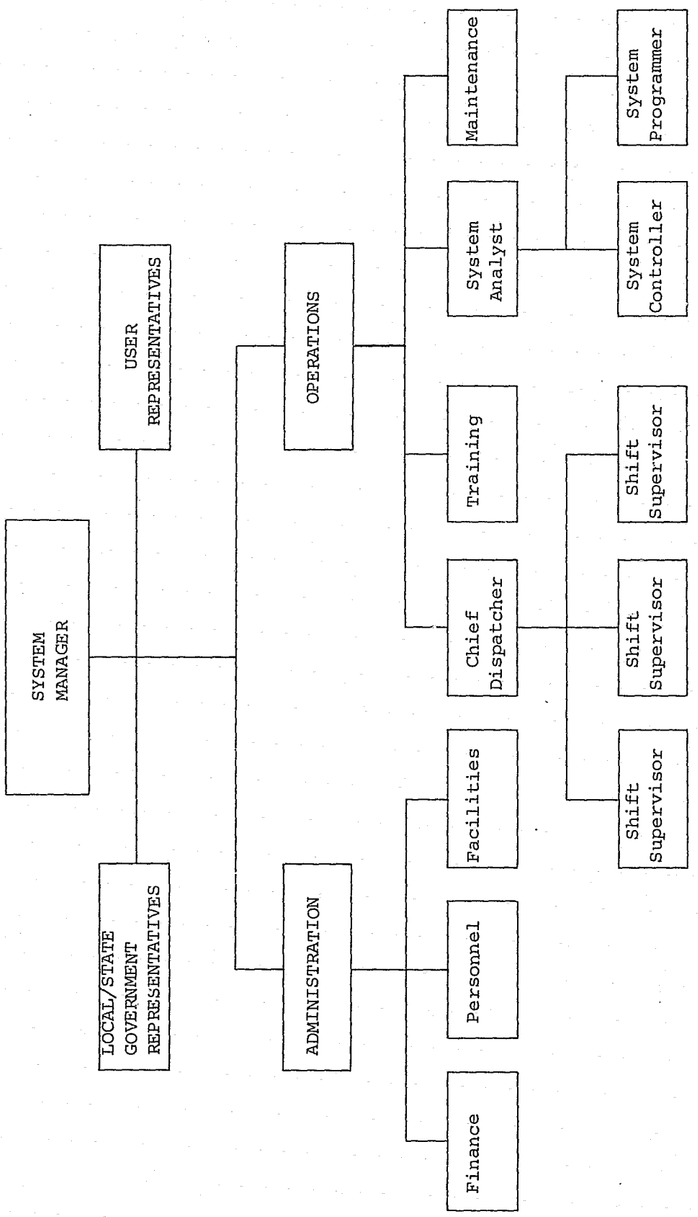
The administrative requirements for managing the new system should be defined. Each should be assigned to a management position or delegated to an outside supporting function. These requirements would include:

- Procurement - The procurement activity could be handled by an established purchasing function of a major using agency. However, the preparation of procurement documentation and procurement approval will reside with the project manager.

- Personnel - The acquisition of personnel and the administration of personnel responsibilities such as salary and benefits are functions which should be assigned to project management.

- Financial - The control of income and expenditures along with the preparation and management of the budget are to be assigned to project management even though dominant financial control may reside at a higher level.

EXHIBIT III-2
Typical System Management Organization



- Security - The degree of security should be appropriate for the facilities and the operating personnel; the administration of this security will be a responsibility of the project management organization.

- Training - Advanced technology systems inherently require higher skill levels to operate and maintain them; the training for these skills is a function of project management.

- Maintenance - Providing for timely and effective maintenance of hardware and software is a responsibility of the project management organization.

These administrative functions and others which may be unique to each specific system must be apportioned as part of the management plan.

3.1.2.2 Responsible Agency/Organization

In defining the administrative and technical requirements for operating the new system, the management plan may assign some of these to the participating agencies. This assignment must be documented in the plan and understood by all concerned. The management plan must clearly define these agency assignments in terms of:

- General Policy - A mutually agreeable set of rules under which certain management functions are to be performed by the participating agencies either as an in-house activity or by assigning personnel to the project management group on a rotating basis.

- Direct Operations - One or more of the participating user agencies may operate the system on the behalf of the other users; management and administrative requirements may or may not reside in that operating agency.

In each case where any responsibility for management or operations is placed in the hands of a participating agency or organization, it should be clearly defined in the management plan and in the agency agreement.

3.1.2.3 Participating Agency Agreements

The management plan that is developed and implemented by the project manager should be approved by the participating agencies. The opportunity to review and approve such management plans should be part of the agency agreements as they were initially executed.

It may be appropriate for the management plan to require a revised set of agency agreements from each participating agency based upon the planned implementation of the system. These new agreements would address the management of the system, as disclosed in the management plan, and the operation of the system. In many cases the original agreements arrived at during system development activities may be adequate, and another round of agreement negotiations would not be necessary.

3.2 DEVELOPMENT OF THE REVISED FUNDING PLAN

The decision to implement the new system concept places new emphasis on the need for a concise and well documented financial plan. Cost estimates were developed earlier as part of the system concept. Further, the decision to implement will have to be supported by funding commitments in the form of local budgets, bond issues, grant funds, or other known funding sources; these are the baseline ingredients for developing the implementation funding plan.

The funding plan must address two major project-related cost categories: implementation costs and recurring operating costs. The funding plan must address each of these as separate problem areas. With the exception of first-year maintenance agreements on much newly purchased electronic equipment, the sources and application of funds differ greatly for these two categories.

3.2.1 Identify Sources of Funds

The sources of funds for implementation must be recognized by the program manager in preparing the funding plan. The availability and amount of these funds should be known from the commitment documentation (grant award, budget narrative, etc.). The use of these funds may be restricted by the method through which they flow to the governmental agency (police, fire, telecommunications office, etc.) responsible for the implementation and operation of the

new system. Funds which are part of a budget appropriation from the general fund of a municipality can frequently be used for implementation and operation. The sources of such finds include:

- Taxes
- Shared revenues from State government
- User charges
- Other municipal revenues (fines, interest income, etc.).

Funds which may be restricted to certain types of implementation which frequently exclude their use for recurring operating costs include:

- State grants-in-aid
- Federal grants
- Grants from private foundations
- Bond issues for capital acquisitions
- Gifts from private sources.

The user agencies can also be a source of funds. The implementation costs (non-recurring costs) can be partially off-set by the assignment of agency property in the form of real estate or equipment. Title to these properties should be formally transferred and recorded. Operating funds (or equivalent service) will most frequently be provided by the user agencies. The agreement to provide these funds or services will be included in the agency agreements. It will be the task of the project management to define the amount of these costs or services that are to be paid and services provided. These arrangements should also be made part of the agency agreement with each user agency.

3.2.2 Develop the Financial Schedule

An overall project schedule was developed for the system implementation as part of the system development activities. This schedule should be up-dated and a financial schedule should be developed that reflects the revised

implementation schedule. (The financial schedule will again be revised when the contract has been concluded with the successful bidders. However, a preliminary financial schedule is required as a basic plan to make funds available as needed.)

The financial schedule will include the following milestones as a minimum:

- The date of each major expenditure of funds and the estimated amount required
- The date and amount from each source where funds would be made available to the project
- The schedule for financial reports from the project manager.

The status of the financial schedule and any revisions needed in the financial plan should be a major part of each financial report.

3.3 CONSIDERATION OF LICENSING AND REGULATORY IMPLICATIONS

The planning for system implementation should also include the scheduling of activities related to the licensing of the new system and taking other actions to satisfy additional regulatory requirements. The extent of these activities will vary with the characteristics and complexity of the new system. The participating user agencies will already be licensed by the FCC. However, new licenses and license modification will be needed in most cases. These are long lead-time procedures and must be planned well in advance of system activation.

The project manager must first determine whether the system concept is in conformance with the laws and regulations and if additional regulatory action is needed. Some of the rules and regulations that apply to higher technology telecommunications systems are discussed in the following paragraphs.

3.3.1 Federal Communications Commission (FCC) Rules and Regulations

All communications systems defined under the Communications Act of 1934, as amended, are subject to the FCC rules and regulations. Of concern to the system planner are those sections which deal with:

- Frequency Coordination
- Licensing Radio Transmitters
- Antenna Support Structures
- Operating Practices.

Licensing procedures can vary significantly depending upon the radio frequency spectrum to be used, the type of radio service, and in some cases, the part of the country in which the system is located. The planner is advised to seek counsel with persons or organizations skilled in the application of FCC rules and regulations.

3.3.2 Federal Aviation Administration

Formal engineering studies of any intended antenna tower construction will be required by the FAA. Similar studies may be required by some states through their Division of Aviation or Department of Transportation.

3.3.3 Federal Statutory Considerations

Other Federal procurement standards should be considered whether or not Federal grant funds are employed in the project. Some of these applicable regulations would include the following:

- National Environmental Policy Act of 1969 - An environmental impact statement may be required for any new construction or modification to existing structures; this may also be required by the State; the system may be judged a major action in accordance with FCC Rules and Regulations (1.1304).
- Clean Air Act of 1970 (PL-91-604)(42USC1857 et seg.)- An environmental impact statement may be required.
- Federal Water Polution Control Act (PL-92-500) (33USC1251 et seg.) - An environmental impact statement may be required; also see FCC Rules and Regulations (1.1311).

- National Historic Preservation Act of 1966 -The effect of implementing the program on the protection and preservation of national historic sites or objects might have to be assessed; see FCC Rules and Regulations (1.1305).
- Occupational Safety and Health Act of 1970 - As administered by OSHA, this act does not apply directly to employees of state and local governments; however, some states have adopted the same or similar regulations which do apply.
- Executive Order 11246 (as amended) - Equal employment opportunity requirements
- Copeland "Anti-Kick Back" Act (18USC874)
- Davis-Bacon Act (40USC276a to a-7) - minimum wage requirements.

The project managers should consult local authorities experienced in the application of these Federal or State regulations for guidance. Adequate time and resources should be scheduled to resolve these licensing and regulatory activities in a timely manner.

3.4 DETAILED IMPLEMENTATION SCHEDULE

An implementation schedule was previously submitted as part of the Master Project Schedule. This schedule must now be up-dated and expanded to enable its use as a management tool to control and report on the progress of the implementation program.

The implementation schedule should be displayed as a graphic time-dependent chart which will be supported by narrative descriptions of each task, each milestone and each reporting point. The complexity of the project will determine the detail of the chart display. The chart and narrative description should be the least complex and detailed as permitted by the size of the project. The types of charts to be considered were discussed in Section 2.2.

3.4.1 Scheduled Activities

The schedule will include periodic schedule review milestones to revise and modify the implementation schedule in accordance with ever changing inputs. In addition, the implementation schedule should include the following items:

- Implementation Management - time scheduled for initiating the project management structure; developing its operating procedures and authority; preparing the management plan; preparing the funding plan; and addressing regulatory considerations.

- Reporting Schedule - the schedule should show all project milestones and dates for the submission of milestone progress reports and financial reports.

- Procurement Document - a schedule should be developed for the preparation of the procurement specifications and other documentation needed for the competitive procurement of the systems and services required to implement the system concept. (Two steps may be required; a request for technical proposals may be required prior to a request for bids based on a definitive system specification.)

- Solicitation of Bids - adequate time must be scheduled for prospective bidders to generate sound technical proposals and cost proposals appropriate to the procurement documentation.

- Contract Award - the award of a suitable contract to the selected bidder may require significant time depending upon the size and complexity of the procurement.

- Facility Preparation - the renovation of existing facilities or the construction of new facilities must be scheduled to meet system installation dates.

- FCC Licensing - when new or modified FCC licenses are required, the Frequency Coordinator should be notified at once; the FCC should also be placed on notice at the same time.

- Equipment Installation - although the installation dates are driven by the supplier's proposal, the relation of these installation dates to all other elements of the implementation schedule must be clearly shown.

- Personnel - the personnel must be identified and trained in a timely manner to meet the system test and cut-over schedules.

- Test and Acceptance - the test program must be scheduled from the first installation test to the conclusion of the acceptance tests.

- Cut-over - a scheduled period for cut-over and/or parallel operation of the old system and the new system must be planned.

- Disposition of Property - the disposition of equipment and facilities replaced or made obsolete by the new system installation must be planned and scheduled.

These schedules are flexible and interdependent. It will be a major function of project management to implement the project in accordance with the implementation schedule and to keep the schedule current with respect to the changing conditions of the implementation plan.

3.4.2 Individual Agency Responsibilities for Scheduled Activities

Scheduled activities should be assigned to the individual user agencies and support agencies in accordance with their known areas of expertise. This policy will keep the program management staff small and will improve the acceptance of the system by increasing agency participation. Typical subtasks to be assigned to the individual agencies could include:

- Preparation of procurement specifications
- Acquisition and preparation of facilities
- Supervision of installation
- Personnel documentation and training
- Licensing and regulatory approvals
- Supervision of test and acceptance
- Procurement of funds
- Financial management.

The agency participation can include the preparation of documentation, the supervision of contractor activities, or the complete delivery of an assigned project task such as licensing and regulatory approvals. These assignments should be mutually agreeable and be supported by written agreements which clearly define the scope of work expected of each agency and the nature of the deliverable products expected.

Each agency can, at its own election, prepare a task schedule for its own activities; this schedule is subordinate to and coordinated with the master implementation schedule.

The master implementation schedule will be revised periodically to reflect new information and modifications to delivery commitments and other project activities. The updated schedule should be provided to all participating agencies. All progress reports should be based upon the latest revised master schedule.

3.5 SYSTEM PROCUREMENT

The procurement of any materials or services that involves the expenditure of public funds must comply with applicable state or local laws and regulations. Federal laws, rules and regulations apply to procurements that employ the use of Federal grant funds. It is appropriate for the project management group to call upon the services of experienced purchasing organizations associated with one or more of the participating agencies for guidance and supervision of all procurement activities related to the implementation program.

The following paragraphs provide general guidance for the basic procurement process. These may be changed significantly by local precedence, and it is advisable that legal counsel be consulted during the preparation of procurement documents and during the competitive bidding process.

3.5.1 Methods of Procurement

Generally, the most cost-effective method of procurement is open and free competition. However, alternate forms of competitive procurement and sole-source procurement can at times be justified. The following paragraphs address the principal forms.

3.5.1.1 Competitive Procurement

Competitive procurement implies that all goods and services will be acquired as a result of the submission and evaluation of competitive offers based on well defined procurement criteria and specifications. The two general procedures are:

- Request for Proposal (RFP) - this procedure is used mainly where system performance can be defined and can be met by the innovative use of hardware and software configurations. It may also be used prior to the preparation of system specifications and prior to an invitation to bid to develop a commercially competitive system configuration. The form is also widely used for the procurement of professional services.

- Invitation for Bid (IFB) - this procedure is used mainly where goods and services are standardized to a high degree and price and delivery are the decisive variables - the IFB is frequently the second step of a two-step procurement in which the first step was a Request for Proposal.

3.5.1.2 Sole-source Procurement

This negotiated procurement form is valid when the required grade or services can be made available only from a single source. Typically, this condition can exist in the following ways:

- The unique skill of a known specialists may be required.

- Existing hardware or software may require updating by its original supplier.

- The required services may be a continuation of an ongoing contract.

- Competition may be precluded by patent rights, or secret processes.

- Competition may be precluded due to emergency conditions or severe time constraints.

Very small purchases of stock items or additions to existing supplies are frequently made by sole-source purchase orders when the value is small and the items have established prices.

3.5.1.3 State Contracts or Other Joint Purchase Agreements

An open contract for the joint purchase of radio equipment is seldom used for the procurement of telecommunication systems. The high dollar value of services such as installation, training, testing, licensing, etc., needed for complete system implementation is difficult to accommodate through the traditional joint purchase equipment contract. However, the planner is advised to also consider the appropriateness of using a joint purchase contract if available.

3.5.2 Contract Forms

System contracts can usually be categorized as one of two forms:

- Turn Key Contract - a single vendor is chosen to provide all of the goods and services needed to install and check-out a completely operational system and, when it has met its performance requirements by test and evaluation, turn the completed operating system over to the purchaser and the purchaser's staff. Although this type of procurement insulates the purchaser from the difficulties of system integration and test, it implies that the chosen contractor is equally proficient in all aspects of integrating a large advanced technology system into the local environment.

- System Supplier Contracts - contracts are awarded to a number of suppliers, each a specialist in providing a particular good or service required by the total system. The project manager and staff has the responsibility of integrating each supplier's product into an operating system; alternatively another contractor can be engaged to provide the hardware and software integration services.

3.5.3 Contract Types

The contract type should be determined by the nature and complexity of the program. Counsel should be sought from a large local procuring activity or from specialized legal counsel. The most common types of contracts include the following:

- Fixed Price Contract - this contract limits the price to be paid for the total effort and calls for a well defined schedule and description of the goods and services to be provided. Different arrangements of this contract type distribute the risk in slightly different ways, for example:
  - Firm Fixed Price (FFP)
  - Fixed Price with Escalation (labor and materials)
  - Fixed Price Incentive (incentive for early delivery, system performance significantly above the minimum specified, etc.)

- Cost Reimbursement Contracts - these contracts are used mainly where there are uncertainties involved in the performance under the contract or in the contract price. Some of the common types include:
  - Cost Plus Fixed Fee
  - Cost Plus Incentive Fee (incentive similar to above)

  These types of contracts are usually negotiated with a target cost or target fee and other means of limiting the purchaser's risk.

- Time and Material Contract - this type of contract is usually used for the purchase of services based upon the amount of labor performed, expenses related to that labor, and the materials used in providing the services. These contracts are frequently used to purchase engineering services, other professional services, or day labor work.

The methods of procurement to be used and the type of contract(s) to be negotiated should be the subject of an early decision in the procurement plan. This decision could greatly effect the preparation of the procurement document and the management of the implementation program.

3.5.4 Procurement Specifications

The procurement specification describes in detail the system and equipment that is to be provided by the contractor or vendor. The specifications usually become part of the contract with the successful bidder and should be prepared with full awareness of the legal as well as technical impact of the specifications.

For the procurement of advanced technology systems standard equipment specifications in the form of industry standards, government standards, or equipment manufacturer's standards are normally not available. The need for competitive procurement also excludes the use of a vendor's specification as part of the procurement document. However, the standard specifications and the offerings of all leading vendors in the field of practice represented by the system concept should be examined in detail to establish the state-of-the-art before the specific system specifications and equipment specifications are prepared. This step may be taken informally by inviting the individual vendors to make technical presentations or more formally by soliciting technical proposals from vendors wishing to respond to prelimanily system requirements outlines. The system specifications will be generated in part from the results of these presentations and/or technical proposals.

The specifications for a public safety or public service communication system should require equipment which is supported by a history of reliability, easily available spare parts, and routine maintenance procedures. However, the advanced technology system may call for previously untested equipment and system configurations to achieve performance goals. The risk will have to be assumed but can be minimized by specifying higher levels of debugging tests and predelivery performance reviews as part of the procurement contract.

The specifications used for system procurement are typically of two kinds; there is a need to describe system performance characteristics in detail, and there is a corresponding need to specify the quality and the characteristics of the items of hardware and software needed to achieve the specified system performance. These will be addressed separately in the following paragraphs with the understanding that both types of specifications are needed to fully describe the system requirements to the suppliers. The specifications are the major part of the bid solicitation. The number of the specifications and the detailed integrity of each specification will depend upon the size and complexity of the new system. It is important to develop the specifications realizing that they will become legally binding upon the contractor and the purchaser alike and that competent suppliers will be unable to respond to specifications that are too restrictive or make demands beyond the state-of-the-art.

3.5.4.1 System Performance Specifications

The required performance of the system elements will have been documented as part of the system concept. The following elements of the system concept become part of the system and performance specifications:

- System configuration
- System operation
- System description
- External interfaces.

These elements of the system concept document should be reviewed to be certain that the descriptions are complete and all technical parameters remain valid and are expressed correctly.

The conversion of the system concept documentation to a system performance specification will also require the addition of other technical elements such as:

- Reliability requirements
- Maintainability requirements
- Allowable tolerance on performance characteristics at internal and external interfaces
- Human factors considerations
- Test and acceptance criteria.

The system specifications should display all of the functional characteristics of the system that would be needed to procure the complete system if the quality and performance of the items of equipment hardware and software were left to the judgment of the contractor.

3.5.4.2 Hardware and Software Specifications

The hardware and software specifications must completely describe the electrical and mechanical characteristics of each item of hardware needed to meet system performance requirements and most completely describe the function and architecture of the computer software needed to meet the system functional requirements.

It is important that the hardware specifications and the operating software specifications reflect readily available and competitive products. To this end the products of major suppliers should be reviewed in detail before the specifications are prepared. Application software will be unique to the system design and may require custom tailoring to meet system requirements. However, major suppliers may also have developed appropriate applications programs, and if these can be used in part for the new system, the cost impact can be substantial.

The hardware and software specifications should be separate from the system performance specifications. For system procurement where the purchaser assumes full responsibility for system installation, system integration, and system test, the hardware and software specifications should be complete enough to enable procurement without reference to the system specification. Hardware and software specifications can also be used alone to purchase supporting system elements such as:

- Physical security systems
- Fire protection systems
- Commercial and emergency power distribution systems
- Manual back-up equipment for automated systems
- Facility construction and renovation
- Interior communication systems
- Personnel training.

3.5.5 Statement of Work

The Statement of Work (SOW) is a precise description of what will be required of the successful contractor in implementing the system. It is used in one-step procurements which require a bid and a technical proposal. It is also used in the second step of a two-step procurement as part of the request for bid (RFB). It will include statements which describe the origin of the procurement, the need for the system, the application of the specifications to system implementation, and will describe all services that will be delivered by the contractor. The elements most frequently found in an SOW are described in the following paragraphs. A discussion of the contents of a Statement of Work will be found in Appendix D.

- Background - This brief historic description of the origin of the project is intended to inform potential bidders of the need for the system and any constraints imposed on the system design by its environment. The participants and the role each plays in the system concept is documented in this part of the SOW.
- Objectives - The objectives to be achieved by system implementation are described. The specifications and their application in meeting the objectives can be introduced in this section of the SOW.

Task and Scope of Work - The specific tasks required by each contractor are described in detail. This section of the SOW will be reflected accurately in the technical proposals and narratives to be received from each compliant bidder. The scope of work will define those services which the contractor will provide in addition to the system hardware and software. These services may include:

- Installation of hardware and software
- Test plans and procedures for hardware and software
- Testing for performance and reliability
- Preparation of operating procedures
- Training of personnel
- Spare parts and assemblies.

The scope of work will also include the requirements for back-up support such as:

- Warranty
- System diagnostic maintenance
- Maintenance Support Agreement (Routine/ Emergency)
- Manuals and drawings

. Contract Deliverables - This section of the SOW will describe each deliverable item under the contract and will define the time, date and place of each deliverable.

. Program Management - This section of the SOW will identify all levels of program management for the project and identify by name the persons responsible for each element of contract performance supervision.

. Schedules - The master program schedule, in a reduced and simplified form, will be presented and described in this section of the SOW.

The completed draft Statement of Work (SOW) and a set of draft specifications will enable the scheduling of a pre-bid conference during which prospective bidders will be invited to comment on the specifics of the intended procurement.

3.5.6 Vendor Conferences

The procurement of an advanced technology communication system justifies the time and effort required for conferences with interested potential system contractors. In general there are two types of conferences which may be scheduled by the planners; informal discussions which usually preceed the issue of a Request for Proposal (RFB) in a two-step procurement, and the formal bidder's meeting which preceeds the receipt of a bid in either a one-step procurement or a two-step procurement. These will be discussed in the following paragraphs.

3.5.6.1 Pre-Proposal Conferences

The informal pre-proposal conference with interested suppliers usually take place before a Request of Proposal is submitted in a two-step procurement. The conference is intended to inform the prospective responders of the nature of the solicitation and to solicit from them system parameters appropriate to the application. Some points to be considered include:

. Attendees - A invitation list of prospective suppliers should be developed from trade sources and previous contracts with equipment/system suppliers.

. Schedule - The conference should be scheduled well in advance of the RFP date so that the conference results can be included in the RFP.

. Conference Record - A record of attendees should be kept and, although informal, notes should be made of any conclusions reached so that this information can be developed for use in the RFP and for later use in the documentation of the Request for Bid (RFB).

The conclusion of the pre-proposal conference should enable the soliciation of technical proposals as the first step in a two-step procurement.

3.5.6.2 Pre-Bid Conference

The formal pre-bid conference with prospective bidders takes place after the Request for Bid (RFB) is issued in the second step of a two-step procurement or after the Request for Bid and Proposal is issued in a one-step procurement. This conference has legal overtones, is formal, and preferrably should be conducted by experienced and qualified procurement officers. This conference will require careful preparation. Care must be exercised that, in the conduct of the conference, the interests of competing vendors will not be jeopardized. Some points to be considered include the following:

- Attendees - A list of potential bidders should be developed from trade sources and from previous contacts with equipment suppliers; each potential attendee should have previously receive draft copies of the specification and SOW.

- Schedule - The conference should be scheduled a reasonable time after the potential attendees have received draft copies of the specification and SOW and well before the bid opening date.

- Conference Record - The proceedings of the conference should be recorded accurately and a written transcript prepared for the file.

- Conference Report - A written report should be sent to each attendee containing answers to the questions raised at the conference and other changes that resulted from the discussions.

The pre-bid conference will provide validation of the specifications and the SOW by providing a forum in which these documents can be questioned and appropriate changes suggested.

3.5.7 Preparing the Bid Package

The bid package for a one-step procurement or the second step of a two-step procurement can be assembled following the pre-bid conferences when all needed modifications have been made to the specifications and the SOW. This bid package will generally consist of the following elements:

- Instruction to Bidders

- Evaluation Criteria

- Specifications

- Appendices.

The Instructions to Bidders section is an introduction to the bid package which should provide the bidder with all the information needed to respond to the bid request. It will identify the purchaser and the person who is to receive the bids. The time and place bids are to be received will be identified. Any instructions regarding the size of the proposal, its construction, or contents will be included. The criteria under which the bids and proposals will be evaluated may also be included in this section.

The municipal entity that is sponsoring the bid request will also have standard legal clauses which must be included in all procurement. These can be included in this section or can be attached as a preamble to this section. Some of the standard clauses are listed in Exhibit III-3. The requirements for insurance and/or performance bonds are usually contained in this section of the bid package.

This section of the bid package should be reviewed by experienced purchasing agents or by legal counsel to be sure that the rights and the responsibilities of all parties are clearly defined.

3.5.8 Issuing the Bid Package

Most advanced technology systems will use the one-step request for bid and proposal as the procurement method. A potential bidders' list can be prepared from inputs to previous technical inquiries made during system development and during pre-proposal conferences. Additional potential bidders can be identified from trade sources and through public advertisement of the bid request.

All potential bidders should receive the same bid package at approximately the same time. The transmittal letter for the bid package should identify a contact person who can answer questions regarding the bid and should identify the time and place of any bidders' conference to be held prior to the submission of bids.

EXHIBIT III-3

Suggested Standard Procurement Package Clauses

Clause Title	Description
Rights to Data	Title to information and data developed under contract
Rights to Proposal	Title to information disclosed in all proposals
Preparation Costs	Disclaim costs an offeror may incur prior to award of the contract
Rights to Reject	Rights of purchaser to reject all proposals
Rights to Cancel	Rights of purchaser to cancel the procurement without committing to contract
Rights to Negotiate	Rights of purchaser to negotiate contract terms
Change Clause	Rights of purchaser to negotiate contract scope changes during life of the contract
Affirmative Action	Need for certificate of compliance
Environmental Protection	Need for an environmental protection statement
Financial Security	Requirements for performance bonds or other surety instruments showing the financial ability to meet contract requirements and liabilities
Audit*	Rights of purchaser to preaward and postaward facility and financial audit
Small Business	Compliance with Federal and State small business and minority business set-asides
Disputes Clause	Procedures for resolving contract disputes

*Not imposed except when required under Federal or State regulations governing the use of grant funds and then only in rigid conformance with appropriate Federal and State regulations.

3.5.9 Bidders' Conference

A formal bidders' conference should be held a reasonable time after potential bidders have received the Request for Quotation (RFQ) in a two-step procurement or the bid package for a one-step procurement and have the opportunity to study its contents. This conference provides an opportunity for bidders to clarify issues related to the system specifications and to the procurement policy.

A bidders' conference is a formal meeting. Attendance can be considered mandatory as a condition for accepting bids if this is so indicated in the RFQ or bid package. Conference reports which provide answers to all questions raised at the bidders' conference should be provided to all attendees. Further technical discussion between the bidders and the project management should be restricted and any changes in the time, data, and place for the submission of technical proposals, management proposals, and cost proposals should be documented. An addendum to the RFQ or bid package should be issued in a timely manner if formal clarification is required.

3.5.10 Bid Evaluation

The criteria by which the proposals are to be evaluated will have been described in the RFQ or bid package (Instructions to Bidders). The selection board which evaluates the bids and proposals should document their deliberations in conformance with these criteria.

The proposal evaluation procedures must insure that all proposals are evaluated by the same method and according to the same criteria. The selection board should represent fairly the project managers and the user agencies. The board should have as few members as possible and represent technical, managerial, and financial skills. It is appropriate for the board to call upon outside specialists in areas where the required expertise is not represented by board members.

The initial procedure is to separate the non-conforming proposals from the conforming proposals. Some of the more frequently observed areas of non-conformance are shown in Exhibit III-4.

EXHIBIT III-4

Representative Nonconforming Proposal Factors

Nonconforming Factor	Reason for Rejection
Surety Bond	Failure to submit a surety instrument with the cost proposal when it was requested in the procurement package or advertisement
Cost Breakdown	Submitted on forms significantly different from the cost breakdown forms requested
Personnel	Failure to identify and commit key personnel to the proposed effort
Facility	Failure to identify and commit key facilities to the proposed effort
Financial Status	Failure to provide proof of financial resources adequate to ensure contractual performance
General Presentation	Excessively ornate or gross violation of proposal size and weight limitations
Cost Proposal	Inclusion of the cost proposal as an inseparable part of the technical proposal when the offeror was instructed to submit a separate cost proposal

Proposals which violate instructions prevent these proposals from being compared item-by-item with conforming proposals. These offerings would normally be rejected from further consideration.

Conforming proposals should be compared and evaluated on an item-by-item basis. The system specification and the equipment specifications provide the identity of each line item of evaluation. Prior to the evaluation, numerical point scores should be established for each item; weighting factors can be assigned to particularly important items of specification. This scoring system should be impartially applied by all evaluators to all proposals being evaluated.

The numerical evaluation of the proposals through item-by-item comparison should be reinforced with additional evaluation criteria which may also be reduced to a numerical score through open discussion and agreement by members of the selection board. These items would include the following:

Understanding the Problem - How well did the officer interpret the problem? Was the background well articulated? Was the problem overstated by expanding it into areas not required by the procurement documentation?

- Method of Solution - Did the proposed solution address the problem that was defined by the procurement document? Is the solution as proposed innovative and valid? Does the solution as proposed conform to applicable laws, rules, and regulations (FCC)?

- Bidder's Background - Does the offeror specialize in the required field and does he have a good record of performance (delivery, quality, etc.)?

- Performance - Has the offeror's cost and technical performance record and system support record been acceptable to other clients? (Check references.)

- Cost - Is the cost proposal compatible with the Statement of Work?

- Organization - Does the offeror's proposed project organization give sufficient management strength for the proposed tasks?

- Personnel - Does the offeror identify and commit to the project adequate numbers of skilled project personnel and project support personnel?

- Resources - Has the offeror adequate physical and financial resources to commit to the procurement (including nearby maintenance shops, spares, etc.)?

- Schedules - Does the evaluator know from the proposal exactly what the offeror is going to deliver, when he is going to deliver it, and what each deliverable will cost?

The evaluation process should continue until it clearly identifies a successful bidder. The successful bidder should be notified and contract deliberations should be initiated. The unsuccessful bidders should be notified as soon as it becomes apparent that a contract award will result from the ongoing deliberations.

The unsuccessful bidders may request post-award debriefings. These should be conducted in private and should be restricted, if possible, to discussions related only to the proposal in questions and to no other competitive proposal. Support for these debriefings is offered by the numerical score developed during proposal evaluation.

3.5.11 Contract Award

The purchasing agent for the host community for each procurement will usually have a standard form contract that has been tested in the courts; this form should be adhered to. The purchasing department will have the proper legal facilities for preparing the contract and the project management group will provide all of the technical back-up material required.

The project manager should consider the following additional contractual items:

- Schedule of Payments - The schedule of payments to the contractor must be compatible with the funding plan that has been established for the implementation program and keyed to milestone deliverables under the contract.

- Subcontractors/Suppliers - The responsiblity of the contractor to adhere to all technical terms, legal and financial constraints of the contract should be passed through to the subcontractors and suppliers (if any) without dilution.

- Performance Bonds - A performance bond should be considered to encourage timely delivery of critical material or services.

- Cancellation Clause - In the event the contractor is unable to meet the system requirements or other major contractual obligation such as timely delivery, the contract should make provisions for contract cancellations under equitable terms; the terms should include provisions for liquidating damages.

* * * * *

With a system supplier under contract, the delivery schedules and the cost schedules should now be revised to reflect the terms of the contract. The project master implementation schedule and supporting subtask schedules should also be revised. The program management attention can now be directed more fully to the questions of facilities and personnel.

3.6 FACILITY ACQUISITION AND PREPARATION

An earlier system development activity provided the identification of all physical facilities required in the system concept. These facilities included the location and characteristics of buildings, real estate, towers, and other property that could be renovated or modified for use in the new system concept. Specifically the system concept defined:

- Dispatch Centers - for command and control

- Buildings - for transmitters, control equipment, staff accommodation

- Real Estate - for new towers or new buildings

- Towers - for radio and microwave antenna support.

3.6.1 Acquisition of Facilities

In all cases, maximum use should be made of existing facilities and holdings; new construction or extensive renovation of existing buildings should be minimized.

The use of property and facilities, whether privately owned of publicly owned, should be supported by properly executed leases or agreements.

3.6.1.1 Dispatch and Control Centers

If the new system requires the consolidation of the dispatch function, it is probable that a suitable dispatch center will be available among the user agencies. This should be reflected in the system concept and should be clearly identified in the system configuration. The configuration of each dispatch center should be developed in terms of human engineering and human environmental conditioning related to operator positions and operator work loads. These requirements should be reduced to detailed work orders and contracts should be let to renovate the centers and facilitate them in accordance with those orders.

An automated advanced technology communication system will also require a centralized location for its control equipment. This computerized system may require a computer-like facility and a control agency to operate it.

An existing computer room, or a room that can be converted to a computer room configuration, should be obtained within the building complex of the selected control agency. Work orders will be required to renovate these facilities and other work orders must be prepared to route the required control links into this location in accordance with the system configuration.

The system contractor will usually provide the project manager with a specification for needed facilities at this location; facilities to be provided by the community. These facilities could include, for example:

- Primary and emergency power
- Heating and air conditioning
- Ventilation and humidity control

- Physical security
- Computer floor construction
- Light conditioning.

These services will have to be contracted by project management unless they are included in the overall system contract.

3.6.1.2 Tower Sites

The location of antennas for the new system should be determined by well documented engineering studies of the radio propagation over the specific terrain and at the specific radio frequency band to be used. To the extent possible, antennas should be located on existing publicly owned antenna towers or support structures such as tall buildings. The need for new antenna support towers should be minimized.

The use of existing antenna support structures, public or private, should be protected by leases or agreements which are properly executed and recorded. In all cases where a new or modified antenna location is specified, FCC licenses will have to be granted for each such location whether or not it is on an existing antenna support structure. If a new tower is to be erected on a leased site or a publicly owned site, an FAA engineering study report will normally be required before the FCC will consider the grant of a license.

3.6.2 Renovation and Construction

The renovation of existing facilities or the construction of new facilities will have to be completed before equipment delivery and installation.

- Renovation of existing facilities can often be accomplished by work orders placed on the local municipal maintenance department. The general floor plan layouts needed for this renovation will be part of the system configuration document. Changes to these layouts, or the layout of alternate facilities, can be accomplished by the municipal facilities maintenance department or by outside contractors.

- Construction of new facilities will probably require the services of a licensed architect to prepare the plans and specifications. Competitive bidding by general contractors will usually be required for public owned building construction. This procedure, and the public acquisition of land upon which to erect the building, can be a long term program. Planners should attempt to use existing buildings and facilities to avoid construction delays.

3.6.3 Power and Climatic Conditioning

The effective operation of an advanced technology communications system requires special consideration of the design of the power distribution system and climatic control system for operation of the system control electronics.

- Power - The control center should be supported by adequate commercial power with a back-up emergency power source to support system operation during commercial power outages. Adequate attention should be paid to the power distribution subsystem. Redundant power feed should be considered so that failure of one power feed bus or one circuit protector will not disable the entire control center. An uninterruptable power supply should be considered for computer-assisted applications which include volatile and critical files. Engineering attention is also needed for the design of the power and communication system earth grounds. These must be electrically compatible with each other to ensure proper operation of the digital communication system controls.

- Environment Conditioning - Many advanced digital computer controlled systems require careful control over the temperature, humidity, and dust or dirt particles in the control center where the digital equipment is installed. The vendor will usually specify these limits and major air conditioning and air filtering system suppliers will be able to meet the requirements with standard units designed for computer applications.

The power system and the climatic conditioning system should be designed for routine and emergency operation. The loss of commercial power is an emergency situation routinely overcome by automatic control of emergency power generators.

operating supervisor personnel which may or may not occupy an active operating position depending upon the size and traffic load of the system.

3.7.2 Skills and Experience

The detailed work load studies for management positions and the development of operating procedures for the operating staff will have resulted in detailed job descriptions for all classes of personnel. These job descriptions will have to be completed and approved before any of the positions are filled.

The job descriptions for each position on the staff will include the skills and experience needed to fill the position. This combination of skill and experience can be verified by comparing it with the skills and experience of personnel who are now performing similar tasks and operations as employees of the user agencies. The training of new personnel and refresher training of present employees will be a contractual obligation of the contractor.

3.7.3 Employment Procedures

Employees are hired and transferred by local governments in conformance with established State and Federal law. The qualifications for available positions should be based upon the job descriptions previously prepared and approved for each position. The project manager will usually find that procedures not in accord with standard policy for the employment of communication personnel will be difficult, if not impossible, to implement.

Typically, the positions will be advertised publicly. The employees of the governmental entity responsible for the system and the employees represented by the user agencies should be encouraged to apply. These experienced applicants must also meet the skill and experience requirements of the job description; the job description must have been prepared with care.

The acquisition of personnel will follow formal procedures and prescribed rules. In general, these procedures will approximate the following steps once a budget has been approved for the position and the pay grade:

- Position Advertising - a public notice of the openings and qualifications of candidates will be posted.

- Application - formal applications from potential candidates will be reviewed and screened for compliance with the job description and position announcement.

- Testing - qualified candidates will be tested for skill, education, and job knowledge; successful candidates will be posted for interviews.

- Interviews - successful candidates will be interviewed and further graded by appropriate officials and the personnel who would supervise the position being offered.

- Probationary Employment - successful candidates will receive a probationary appointment with the condition that they pass the training requirements and other tests prescribed for the position.

- Training - most positions require the probationary employee to pass proficiency tests showing skills learned in the training program. Some positions, notably dispatchers or complaint takers, call for stress training and stress testing. Professional assistance must be used in employing any stress training or stress testing techniques.

- Employment - a permanent appointment is usually offered to the candidate that fulfills the requirements of the probationary appointment and fulfills job requirements.

These employment procedures and policies will differ between communities and with the size and complexity of the system being implemented. They are typically time consuming and the project manager should give them careful consideration in the implementation schedule.

3.7.3.1 System Manager

It is appropriate to recruit the system manager very early on in the implementation program. This will enable that person to participate in the employment of all subordinate personnel and to participate actively in the implementation of the system.

A likely source of candidates for this position is the project management group that directed the system development activities and/or the system implementation activities. The next most likely sources are the user agencies or supporting agencies. Because the position will normally require a public announcement, there will also be qualified applicants from outside of the participating organizations.

3.7.3.2 Operating Supervisors

The supervisors of the operating staff should be the next group to be recruited. This should be completed by the time the system hardware and software has been installed and the vendors are ready to conduct their training programs. The supervisor group should assist in the debugging test and acceptance tests as part of their training.

The supervisors will also be trainers for the operating staff and their job descriptions should express this requirement along with other specified skills and experience.

The supervisors can also be recruited from among the user agencies and other public safety agencies having similar communications systems. Normally, these positions will also be advertised.

3.7.3.3 Operating Staff

The hiring of the operating staff should be coordinated closely with the acceptance test and inauguration of the operating system. The initial staff should be hired and trained by the date the new system is scheduled to come on-line. However, the staff should not be trained and in place much before that date.

These positions will be advertised in accordance with the skill and experience requirements called for in their job descriptions. Candidates should be available on transfer and reassignment of user agency personnel and from outside local government.

3.7.4 Training

The initial training requirements should be imposed upon the system suppliers as part of their contract obligations; it is one of the services that they will provide under their contract. The initial training should take place after the operating supervisors have been appointed and before final test and acceptance of the system is complete.

The software configuration of computer controlled automated systems should provide an on-line training mode of operation in which operator procedures can be exercised on the system hardware and software, without disturbing the routine operation of the system. This training mode requirement must be included in the system specification and in supporting hardware or software specifications. If the nature of the system prevents the configuration of an on-line training mode of operation, the specifications should then call for a training simulator which will duplicate system operation off-line.

The training requirements of the contractor should include initial training of selected personnel and also the delivery of training materials and training equipment adequate for the purchaser to train additional personnel in operation of the system and to provide refresher training to update staff skills.

3.7.4.1 Operations Training

The initial training program conducted by the contractor(s) should include as trainees all operating personnel, the system manager, the operating supervisors and senior field officers of the user organizations. This training should be conducted at the site which offers the best training facility; the installation site or the suppliers' training location. The level of training should not be compromised by holding it at the installation site if the contractor's location offers better training equipment and facilities.

The training program will have been developed by the contractor and approved by the purchaser as part of the system contract. The contractor will train all of the initial staff, the supervisors and managers. The students should be trained to operate the system in any of its routine or emergency modes including degraded operation. The training program must provide hands-on experience with an operating system.

3.7.4.2 Maintenance Training

The contractor should provide special maintenance training. Employees of the system staff and employees of the maintenance agency for the system should be trained, in accordance with the approved maintenance plan.

Maintenance instructions for the items of hardware and for the software system should be provided. The candidates for these maintenance programs should be employees already skilled in their fields of interests and should not include unskilled or semi-skilled individuals.

Maintenance training should be conducted prior to the shakedown and acceptance tests on the system. The trainee candidates can then assist in bringing the system on-line through the shakedown and acceptance tests thereby providing additional on-the-job training prior to the system inauguration.

3.7.4.3 Operating Procedure Manuals

Operating procedure manuals should be the main texts used in the initial training and in subsequent training programs. These manuals should be revised and improved where indicated by the results of the training program.

The functional procedures defined by the system concept provide the basis for developing detailed operating procedures for the new system. The operating procedures will reflect the size and complexity of the specific system.

The operating procedures will address primarily those areas of the system where system control is exercised; the man-machine interface. A useful tool to define operations are system flow diagrams such as:

- Information Flow Diagram - This diagram shows graphically the flow of all information through the system from input to output including each interface and each decision point. It specifically indicates at which points information must be added into the system to effect decisions. A sample diagram is illustrated in Exhibit III-5.

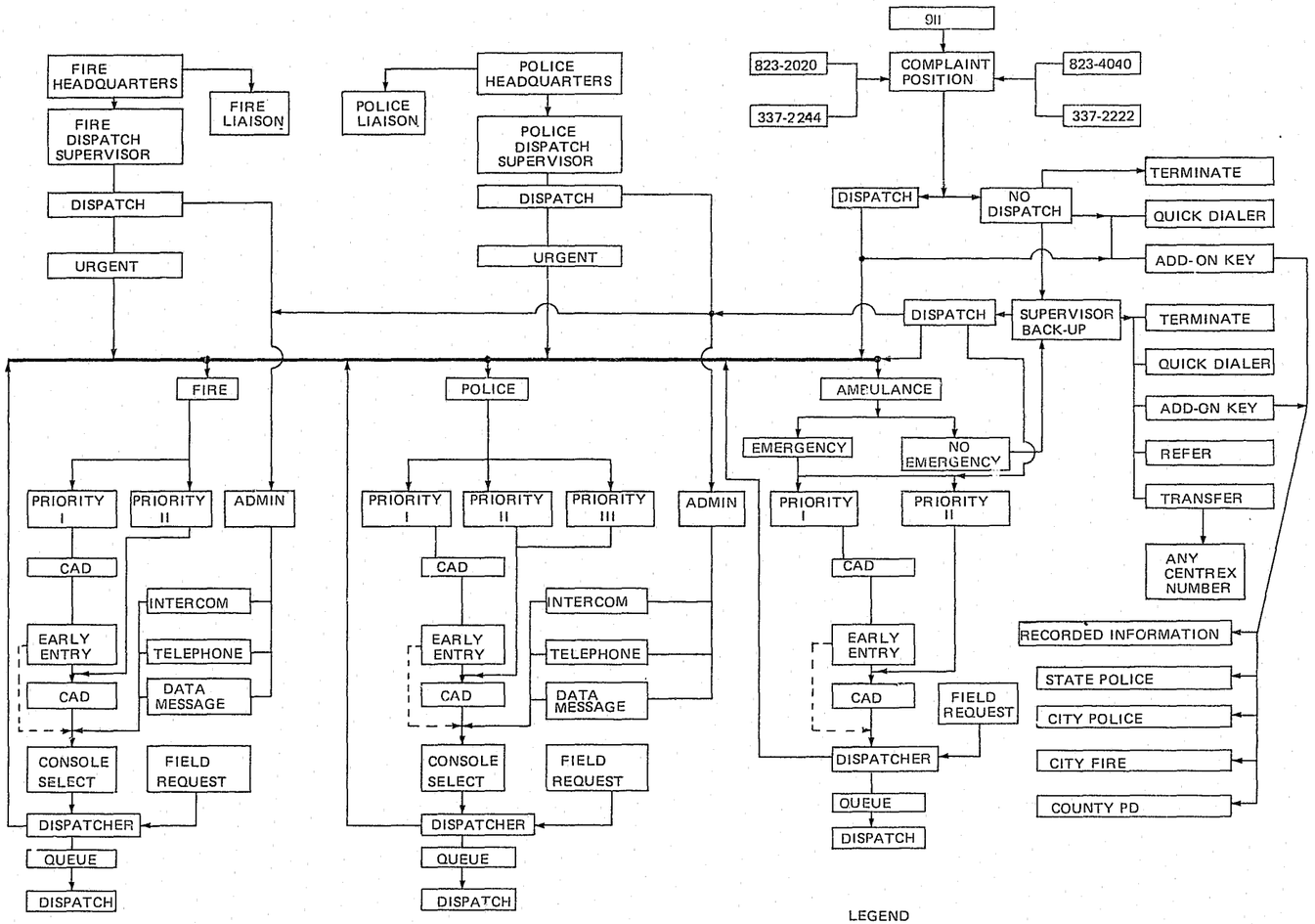
- Personnel Flow Diagram - In those systems where the movement of personnel affects system operation, a graphic flow diagram representing this movement can be a useful tool. Such a diagram is also useful in planning physical security for normal operation or back-up manual operation.

These graphics will illuminate those decision points in the system where intervention, such as the review of information; adding of information, exercising control, or taking information out of the system flow, will take place.

CONTINUED

1 OF 2

EXHIBIT III-5
Typical Information Flow Diagram



The operation procedures manual should also address:

- Control Positions - Control positions are points from which the flow of information in the system can be modified. These should be shown in the system flow diagrams. A written procedure should be prepared which describes precisely how the control function is accomplished at each point.

- Manual Operation - The advanced technology systems and their flow diagrams normally assume automatic or semi-automatic operation. The operating procedures plan should also provide for full or partial manual operation in the event the automatic features of the system become inoperative. Procedures for manual operation of the system, duplicating the information flow diagrams, should be prepared in detail.

The written procedures generated for each operator position and each control position for automatic and manual operation are the basis for developing the procedures manuals for the system operation. These procedures and procedures manuals should be completed before the initial operating staff for the system is acquired; they will become the basic text material in training these personnel. The procedure manuals support the day-to-day operation of the system and aid in its maintenance.

3.8 EQUIPMENT IMPLEMENTATION

The equipment implementation should be a contractual responsibility of the system contractor(s). The project manager and the system manager will supervise this implementation and inspect all facets of implementation to be sure the requirements of the system specification and the equipment specifications are met. The principal elements of equipment implementation are discussed in the following paragraphs.

3.8.1 Installation

The responsibility for timely delivery and installation of all items of hardware and software rests with the system contractor. The installation must be completed in accordance with the time schedule which is part of the contract. The installation must also be made in accordance with local codes, standards, and ordinances also called

out by reference in the contract. The quality of the installation and attendant workmanship will be covered by the system specification and the equipment specifications.

The installation schedule is probably the most fluid of the project schedules and the one that frequently proves to be the most difficult to control. Careful planning and frequent review of the plan and the progress are essential to achieve a timely installation of the hardware and software.

The responsibility for supervising the installation resides with the project manager. The project manager will inspect each installation to confirm that these have been completed in accordance with the contract specifications and the project schedule. The project manager will perform inspections and will monitor the work to be sure these requirements are being met. The project manager should issue periodic reports which evaluate the quality and timely performance of the contractor's installation program and will designate areas where corrective action is required.

3.8.2 Contractor Testing

The contractor should conduct a series of tests and debugging operations to document that the equipment and software installed meets the system specification and the equipment specifications under the contract. The contractor tests conducted prior to the submission of the system to acceptance test and evaluation should be conducted with the full assistance of contractor personnel and project personnel. These tests are outlined in the following paragraphs.

3.8.2.1 Installation Tests

The contractor will test each item of hardware and software as it is installed to be certain that its operation has not been degraded by shipping the item and installing it in the system environment. For example, repeaters and base stations are checked out individually upon installation. These tests are typically conducted by contractor personnel and need not be otherwise documented. They may be monitored by project personnel. At this time in the implementation program the equipment and software remain the property of the contractor.

3.8.2.2 Shakedown and Debugging

The contractor will begin shakedown tests and debugging tests when equipment and software have been installed in

sufficient quantity to integrate the functions and simulate system performance. For example, as soon as the software program is loaded into the computer system, preliminary tests are run which include the controller, all terminals, and the printers. These tests are usually conducted by contractor personnel. The operating supervisors should be available at this time to assist in the testing. These tests will approach, if not achieve, system performance requirements. They are often decisive in determining whether or not the system can achieve acceptance. They should be documented and evaluated for specification compliance. The project management should monitor these tests and evaluate the test results. A formal system for reporting defective operation should be initiated so that written records exist for each defect and each corrective action.

3.8.3 System Acceptance and Evaluation

The system contractor will be responsible for preparing the system acceptance test procedure. The project manager will have the responsibility of reviewing this procedure and approving a mutually acceptable document. The system acceptance tests will be performed and evaluated in conformance with this approved test plan and test procedure.

3.8.3.1 Responsibility and Authority

The system contractor has the responsiblity to run the test in conformance with the approved acceptance test plan and test procedure. The community should have the authority to accept or reject the system on the basis of the test results.

3.8.3.2 Test Plan and Procedure

The acceptance test will be run by the contractor in strict compliance with the approved test plan and test procedure. This document will have been negotiated between the system contractor who prepared the plan and the project manager who will evaluate the plan for its conformance with the system specifications. The acceptance criteria should be based upon the ability of the test plan and test procedures to demonstrate compliance with system specifications.

3.8.3.3 Schedule

The schedule for the acceptance test demonstration should be mutually agreed upon between the system contractor

and the project manager. It is preferred that the test procedures be implemented by personnel representing both the contractor and the system manager. The schedule for the test should conform with the overall project schedule.

3.8.3.4 Test Results and Documentation

The acceptance test results should be carefully documented. The performance limits of each test should be expressed as part of the test description. For complete acceptance, all tests performed should fall within the assigned test limits.

Tests conducted on complex electronic systems do not always result in clearly acceptable procedures. The classes of test defects can be categorized as follows:

- Minor Test Defects - these can be repaired by adjustment or replacement of a defective subassembly and the test can be rerun and the testing procedure continued.

- Functional Defect - these result from improper functions being performed by a hardware or software element; the contractor can repair the defect within a reasonable time and those portions of the test can be repeated after the deficiency has been corrected. It may be necessary to repeat the entire test procedure.

- Major Defect - this defect, as demonstrated by the inability to meet specifications, may prevent the system from being accepted.

In the development of the test plan and test procedures, recognition of the test defect categories should be clearly documented and remedies or other corrective actions should be prescribed for each category.

3.8.4 Cut-over Plans

System acceptance implies that the cut-over of the existing system operation to the new system operation is imminent. A cut-over plan that will be acceptable to the user agencies will be required. The two basic procedures for implementing a cut-over can be categorized as follows:

- Parallel Cut-over - the old system and the new system are operated in parallel until confidence in the new system permits operation to be transferred completely.

- Sequential Cut-over - One function at a time is cut-over starting with the minor functions and proceding sequentially to the major functions until all functions are assumed by the new system.

- Brute Force Cut-over - at a predetermined time operation of the old system is terminated and is completely assumed by the new system.

For a multi-agency operational cut-over, it is appropriate to cut over one agency at a time using either parallel or brute force techniques. There are many local factors that will determine the order of cut-over. In general, consideration should be to bring those agencies on-line first who have the lower traffic loads. The higher traffic load agencies will then be cut-over after the system staff has had on-line real-time experience and will be more confident in handling the higher traffic load. Evaluation data collection should be implemented at system cut-over.

3.8.5 System Documentation

The system documents that are required should be clearly defined in the system contract. The contract has not been satisfactorily completed until all of the documents have been delivered in the number specified and each document has been corrected to represent all changes made during installation and test.

The minimum of documentation that would be required by an advanced technology communication system includes:

- Manuals - the manuals to be provided by the contractor will include the following:

  - Operation Manuals - for each operating position; should be provided in a number adequate for use as training texts as well as reference material at each position. These should be bound in a way to permit frequent revision.

- Quick Reference Cards - each operating position should be provided with quick reference cards developed from the operation manuals for each position.

- Maintenance Manuals - detailed enough to permit repair and adjustment of any sub-assembly of any hardware item should be supplied; these should include schematic diagrams, functional diagrams, and trouble shooting guides.

- User Manuals - user manuals should be provided for the operations software and applications software for computer controlled systems.

. Drawings - should be provided showing the mechanical and electrical installation of each item of hardware. The drawings will include the interface connections to the outside supporting systems such as power, telephone, microware, recorders, alarms, and other services. The drawings should include wiring schematics for the power distribution system and the signal distribution systems. The drawings should represent the system as installed in the facility.

. Spare Parts Lists - the system contractor should provide a list of recommended spare parts and spare assemblies. The quantities recommended should support the system configuration for at least one year or until operating experience with the system has developed a more accurate measure of the required quantity of each recommended spare. A separate list of spare parts to be provided during the warranty period should also be included.

Other system documentation may be recommended by the system contractor in the bid proposal or in later negotiations. These recommendations should be evaluated carefully with respect to system requirements and cost.

In the performance of its functions as a public-safety communication system the system may require other documentation not provided by the system vendor. The project manager through the user agency coordinators should develop

a list of these recommended local directories and documents. These documents should also be on hand at system cut-over.

The equipment implementation and cut-over does not complete the system management responsibilities. The system manager and staff will continue the operation of the system and will continue to evaluate its effectiveness in solving the system problems it was designed to overcome. A program of evaluation data collection should be implemented.

3.9 POST IMPLEMENTATION SUPPORT

The post implementation support program will address both funding and staffing for sustained operation.

3.9.1 Continued Funding

The one-time investment costs related to the system procurement and implementation can frequently be off-set by State or Federal grant funds. This is usually not true of the recurring costs of continued operation of the system.

Recurring costs will include the following:

. Personnel - salary and benefits

. Maintenance - the maintenance of the facility and electronic equipment/software after the first year

. Equipment Replacement - the periodic replacement of worn or obsolete items of hardware and software

. Leases or Rent - the periodic charges for occupying the facilities or use of third party equipment

. Utilities - the periodic charge for heat, light, telephone, air conditioning, power, water, sewer, and other services supplied by a third party

. Supplies - the expendable materials used in operating the system

. Training - the cost of periodic training of replacement personnel and up-dating the operating/maintenance staff personnel.

Each of these recurring cost requirements should have been examined and dimensioned during the system development

program; they were evaluated in the system concept document. These items should again be examined during the planning elements of the system implementation program and detailed in the implementation funding plan. Providing these funds will typically fall to the user agencies; distributed among them by a mutually agreeable formula which reflects the potential value the system has for each participating agency. The formula for the partitioning of the cost among the agencies will be part of the written agency agreements.

There must also be a mechanism by which these costs will be billed to the agencies, collected from the agencies, managed and audited. These funds should not normally be included as part of the general accounts of any one agency; even if one agency has assumed full responsibility for the operation of the system. Separate financial accountability should be implemented for the continuing funding of the system. The complexity of this financial control mechanism should be minimized within the constraints of accountability.

3.9.2 Personnel Replacement and Training

The replacement of personnel and the up-dating of staff personnel can be a recurring problem which will vary with the type of system. Systems which include high stress occupations such as public safety, dispatching and complaint taking, typically experience high personnel turnover rates and the corresponding need for frequent training and motivation. Systems which are remote from the public access functions and the burdens of dispatching usually do not experience such high personnel turnover rates.

3.9.2.1 Personnel Hiring or Transfer

The hiring or transfer of new personnel or replacement personnel requires the application of the same personnel procedures outlined for the acquisition of the initial staff. Periodic examination may be appropriate for the first line personnel positions in order to provide a list of qualified candidates to fill openings as they occur.

3.9.2.2 Training

The two levels of training that should be considered are the following:

- Entry Training - for new and replacement personnel; follows the same training program used for the initial staff and is taught by the supervisor/ instructors.

- Refresher Training - is usually required because of changes made in software and equipment functions as the system matures; usually taught by the supervisor/instructors.

Training should be considered as a means of motivation in addition to its role in support of proficiency.

3.9.3 Support Staff

The project should have the full-time services of equipment maintenance personnel and software systems personnel. The number of these and their skill levels will depend upon the complexity of the system. However, the software staff should consist of at least one systems analyst supported by at least one senior systems programmer. The hardware maintenance personnel should be fully qualified, experienced, and equipped to perform any maintenance task except the most unusual.

* * * *

The position of the system management in the hierarchy of the local government organization will determine the extent of involvement the system manager will have in the personnel process. Regardless of system size and complexity, the motivation of the operating personnel is key to the success of the system.

3.10 SYSTEM EVALUATION

Post implementation evaluation is required for projects in which Federal grant funds under the Omnibus Crime Control Act of 1970 and the Crime Control Act of 1973 (P.L.93-83) are used. The requirement is clearly defined in the LEAA Guideline Manual (M4100.1D) "State Planning Agency Grants." The stated objectives of the evaluation program are:

- To gauge the success of implementation

- To demonstrate efforts to improve the quality of law enforcement and criminal justice

- To provide a basis for updating and revising future plans.

The system implementation will be obliged to meet these requirements if funding is achieved under these Federal programs. Post implementation evaluation is also recommended for those systems not funded by Federal grants.

Some of the elements of post implementation evaluation are described in the following paragraphs.

3.10.1 Evaluation Plan

The execution of the evaluation plan must result in an evaluation report that will meet the requirements set forth in the LEAA Guideline Manual (M4100.1D). The evaluation plan should address two principal questions:

- Did the project accomplish what it was planned to accomplish?
- What side effects, desirable or undesirable, can be ascertained from project operation?

The development of the evaluation plan should be initiated with the system development activities. During the original documentation of existing systems and during the period of problem analysis and solution, information should be developed for the baseline system evaluation criteria. Data, describing technical performance and operational performance of the then existing systems form the base against which quantitative measures of improvement can be established. The technical and operational requirements for the new system are also documented during the system development activities. These requirements, and the performance measurements of the old system are the ingredients from which the evaluation plan is developed.

Execution of the evaluation plan should begin during system shakedown and debugging tests when the system configuration and operation have been stablizied. This should continue through the acceptance tests where as many as possible of the evaluation test parameters and procedures should be exercised. Therefore, the evaluation plan should delineate:

- The kinds of data to be recorded
- The procedures for measuring the data
- How the data is to be recorded (forms to be used)

- When the data is to be recorded (how often)
- The configuration of the evaluation reports
- The distribution of the evaluation reports.

The system manager will recognize that, as the system matures, its performance and operation will probably change. The periodic evaluation report can be instrumental in bringing about these changes in an orderly manner.

3.10.2 Scope of Evaluation

The evaluation report(s) should include all elements of program and project performance. Continued support by local, state, and Federal agencies will be strengthened by evidence of results-oriented management. Some of the elements to be included in the evaluation are outlined below.

3.10.2.1 System Effectiveness

A determination should be made as to whether the system is satisfying its role; and if the system inputs and outputs are used as specified in the system concept. System parameters that have modified the system use or performance since implementation should be identified.

3.10.2.2 Technical Evaluation

The intent of this evaluation is to determine how well the system specifications and equipment specifications are being met. The considerations include:

- System Performance - determine how well the operational requirements are being achieved; reliability and maintainability performance is included.
- Equipment Performance - how well each major item of equipment is meeting its performance specification.
- Operation - if the level of skill needed and the number of personnel needed are compatible with the system plan and system operation.
- Maintenance - if the level of maintenance planned and the vendor support services and warranty have been adequate.

- Technology - if the advanced technology features of the system hardware and software have been effective in meeting system requirements.

- Special Characteristics - if the installed equipment and software include unexpected features not contemplated in the system design or specifications.

3.10.2.3 Financial Evaluation

Advanced technology programs should be evaluated on the basis of worth and value to the user agencies. Some of the items of financial evaluation that should be considered include the following:

- Investment Cost - Determine if the cost of procuring all goods and services was within budget and was cost-effective.

- Operating Costs - Determine if operating costs are within budget plans and are the minimum compatible with effective service.

- Cost Control - Determine if accounting and control procedures are within acceptable audit standards.

- Value Standards - Determine if target values in terms of performance-per-dollar-spent by the user agencies are being achieved.

3.10.2.4 Management Evaluation

The evaluation of the system management should include some of the following considerations:

- Organization - Determine if the organization structure is the most cost-effective structure for the size and complexity of the system.

- Interrelations - Determine the adequacy and effectiveness of interrelations with the user organizations and local governments.

- Controls - Determine the adequacy of cost and management controls with respect to meeting budgets and performance schedules.

- Skills - Determine if adequate management, technical, financial, and legal skills have been made available to system management.

3.10.3 Data Resources

The data specified in the evaluation plan can be recorded at the appropriate intervals. Other appropriate data can be accumulated on a routine basis and analyzed at the evaluation intervals. Some of these routine sources of data include:

- Operation Logs - Logs of system operation that show traffic loads, traffic load distribution, delay time, system up time, system down time, channel wait time, and other system operating parameters.

- Maintenance Logs - Records of maintenance and repair activities which show parts or assembly replacement and the costs of maintenance.

- Test Reports - Periodic tests that are conducted either for maintenance or routine testing should be reported in a standard form.

- User Complaints - A record of complaints of system operation should be available.

* * * *

An evaluation plan which results in periodic management reports is an important management tool. The use of such a plan should also receive consideration for those systems where the source of funding does not make formal evaluation mandatory.

APPENDIX A

SUGGESTED AGENCY AGREEMENTS

APPENDIX A

SUGGESTED AGENCY AGREEMENTS

I. INTRODUCTION

The agreement by two or more local government public-safety agencies to enter into a joint enterprise which provides a mutual service of value to the participants is best documented by written agreements between the parties. By their nature, these agreements are highly individual, tailored to specific requirements of each program in each locality. This appendix to the System Implementation Planning Guide (SIP) is intended to suggest only a general outline of such agreements. The details and the order of presentation will depend upon each kind of enterprise contemplated, its complexity, and the immediate cooperative environment. Legal counsel should be consulted.

1. Purposes of the Agreement

The purpose of a written agreement is to describe the reason for the cooperative effort and the results that are expected to be achieved through mutual participation. By reducing this to a clear and unambiguous written statement, the involved parties will fully understand their mutual participation. Equally important, the governing bodies, of which the participants are a part, will be able to determine the true nature of the program and the expected results and thereby provide their support.

2. Scope of the Agreement

The agreement should define the dimensions within which the terms of the agreement apply. The responsibilities and liabilities of each of the participants should be clearly documented. There should be no unwritten understandings between the parties.

The following model outline of an agreement form provides a series of topical considerations to be evaluated during the development of an interagency agreement. The precise form of a specific agreement, and the language to be used in each case, should be provided by legal counsel. In many cases, standard legal form and substance is required by State or Federal regulation.

II. SUGGESTED MODEL OUTLINE

The following topics and items are intended to delineate key considerations in the preparation of an interagency agreement.

1. General Terms and Legal Base

The general terms will include the following as a minimum:

- The identification of each participating agency
- The requirements to be imposed on those agencies that may wish to participate at a later date
- The concise purpose of the joint enterprise and the mutually advantageous results that are expected to be achieved
- A statement of the legal authority under which the public agencies are able to contract with each other for the stated purpose; this may be a state law, a local government act, a series of resolutions passed by the local governmental authorities, or similar authorization.

2. Services to be Provided

The services provided by each agency and to each agency will be defined. These include the following considerations:

- Definition of the services to be provided by each agency to the mutual system; these services could include, for example, equipment maintenance, equipment, facilities, operating manpower, support services, and similar items of value to the system.
- Definition of services the system will provide to each participating agency; such services could include the dispatching of field forces, management reports, statistical data, and similar items of value to the agency.
- The definition of the quantity or extent of each service to be provided.
- The responsibility each agency has for delivering its service and the responsibility the mutual operation has for delivering its services to each agency.
- The extent of any back-up or redundancy to assure that services are delivered in a timely manner throughout the life of the agreement.

3. Liability

A key element of the agreement between two or more public agencies is a clear definition of the liability each of the agencies has for the actions of other parties to the agreement. This is particularly true if one or more of the agencies provides public services on behalf of the other agencies. Agreements to limit the liability exposure of participating agencies would include the following considerations.

- Responsibility for defending the provider agency in potential lawsuits.
- Indemnification of the providing agency against liability judgements against a participating agency.
- Indemnification of the participating agency against legal actions or liability judgements against the provider agency arising from the normal provision of agreed-to services.

4. Amount and Manner of Payment

The providing agency must be reimbursed for the expenses of the service it provides to the participating agencies. A portion of this obligation will fall to the individual participating agencies. The agreement between the agencies must be specific regarding this individual responsibility and will be definitive of the following considerations:

- The specific services to be provided and the cost of each service
- The method by which the cost and value of each service is calculated
- The means of payment for example: cash, in-kind services, cash equivalent in material or equipment, and any other valuable consideration agreeable to the parties to the agreement
- The time and manner that payments are to be made
- The use of outside funding sources such as grants or gifts.

5. Fiscal Procedures

Sound fiscal planning is key to the successful implementation of public agency cooperative programs. The responsibility of the provider agency for financial integrity must be defined in the agency agreements. The agreement will specify the following elements:

- The type of financial records and how they are maintained
- The contents of the periodic financial reports and the schedule for submitting these reports to higher authority and to participating agencies
- Access to the financial records by each participating agency

- Certification and/or audit of the records and financial reports
- Terms and conditions relative to the periodic reassessment of rates charged for each service provided.

6. Administration

The administrative structure of the cooperative program should be defined in the agency agreements. The authority and responsibility of each agency for participation in policy administration and the authority and responsibility for day-to-day operation should be included. Some of the key elements in the agreement are:

- The identification of the person(s) authorized to sign the agreement on behalf of each party to the agreement
- The identity of the person(s) who will represent the participating agency and providing agency in policy matters
- The responsibility and authority of the providing agency to supervise project personnel and establish personnel policy
- The responsibility and authority of the providing agency over joint-use facilities and equipment
- The retention by participating agencies of control, responsibility, and authority over their personnel, facilities and equipment that may be used in the cooperative project
- Identity and authority of persons responsible for the review of the agreements and for the determination of compliance.

These and other administrative elements suitable to the unique environment and nature of the proposed project should be negotiated between the parties and made part of the written agreement to participate.

7. Real Property and Equipment

The cost-effective implementation of a multi-agency cooperative program should make maximum use of facilities, property and equipment available from the participating agencies. The agreement should identify these properties and materials; it should establish the rules under which the properties and materials are to be used. Some key considerations are:

- Identify each item of property and equipment that is to be transferred to the use of the cooperative system
- Establish the value of the property and/or equipment and show the method used to establish the value
- Provide for the return of the property and equipment upon termination or cancellation of the agreement
- Define the method to be used to establish the value of property and material to be returned to the original supplier upon the termination, modification, or cancellation of the agreement.

8. Duration, Termination, and Amendments

The agency agreement must provide for modification to the agreement during its term. It must also define the duration of the agreement, make provisions for cancellation of the agreement, and disclose how the agreement is to be terminated. The following items should be included:

- The term of the agreement
- The circumstances under which the agreement can be terminated during its intended duration
- The terms under which the agency can withdraw from the agreement
- The circumstances under which either party can cancel the agreement

- Procedures for amending the agreement during its intended term
- Disposition of property and equipment upon termination or cancellation.

9. Other Provisions

The agency agreement is a custom document generated to reflect the unique needs of the specific circumstance and the environment in which the mutual agreement is being generated. Each agreement will include terms and conditions of an individual nature. Key among these are the following suggestions:

- Method of resolving disputes; for example, arbitration, application of appropriate State or Federal laws, etc.
- Identity of the court of jurisdiction for adjudicating disputes.
- Definition of terms used in the agreement.
- Statutory status and filing of the agreement.
- Interrelationship of agreements.

* * * * *

The drawing of interlocal contracts and agreements to provide public services or hold public property for the mutual advantage of multiple governmental organizations may be subject to local, state, or Federal regulations and/or laws. These documents should be drawn up under the advice of legal counsel to insure their status as legal instruments.

APPENDIX B

DATA ACQUISITION

APPENDIX B

DATA ACQUISITION

I. INTRODUCTION

The initial step to be taken in defining the requirements for a new system is to establish an effective data base. This data base is a collection of relevant factual information organized to enable rapid retrieval and comparison of data. The data base provides information on the status of the existing communications system, its resources, and its management. The data base also identifies system deficiencies that justify the need for an improved system, documents the required system performance, and establishes implementation priorities through the quantification of needs. The data base will also document those system performance parameters to be used in post-project evaluation.

The data base should be limited to information directly useful in developing a concept design that is responsive to the project objectives. The first step in development of the data base is to identify the objectives to be achieved in implementing the project and then determine the elements of data which must be acquired to support these objectives. The objectives must justify the implementation of the new system. Section II of this Appendix will discuss this task. Having decided on the scope of data to be acquired, the method of data acquisition must be developed. Methods of data acquisition are discussed in Section III.

II. DETERMINE THE TYPE OF DATA NEEDED

The development of an effective data base will require the active cooperation of the system user organizations. The cost-effective approach to this effort is to identify the scope of data needed to develop the system concept in accordance with system objectives, identify the data needed to compare final system performance, and limit the data collection to these types of data. This will minimize the time needed by the project staff and the personnel of the user organizations and will enhance the credibility of the program.

1. Define Project Objectives

The objectives to be achieved by the implementation of the project should be clearly defined and accepted by the participating organizations. These objectives are key to the identification of the type of data needed in the data base and, equally important, the type of data that is not needed in the data base. For example, if the objective of the project is to replace a technically obsolete VHF low-band, half-duplex radio system with a new 800 MHz conventional duplex radio system, data that might be required would include:

- The assignment of portable radios and their use
- The number and assignment of mobile radios
- The location and availability of base station antenna support structures
- Radio coverage problem areas
- Performance data on the existing system.

Data that we might not need for this specific problem could include:

- The type and model number of existing low-band portables
- The type and model number of existing low-band mobiles
- The type and model number of base station antennas.

Other project objectives will dictate similar variations in the data needed to proceed with a concept design. It is recommended that data acquisition be restricted to the needed data and that the plan to collect the data be structured to these limitations.

2. Identify User Organizations

The system user organizations who will participate in the data acquisition, data collection, and plan must be identified. In general, there will be two categories of users as defined in the following paragraphs.

(1) Principal Users

The principal users of the communications system will be those for whom the communications system is a critical element in their operating capability. They typically employ most of the resources of the system. These agencies will determine the concept of the new communications system, and the data acquired from them as part of the data base must be complete and accurate. Some of the characteristics that identify the principal user organizations include:

- Radio dispatch responsibility for themselves and other agencies
- Primary response requirements for emergencies and disaster operations
- Public safety responsibility for the protection of life and property
- Full-time public service operations such as public transportation and urban traffic control.

Most of the time planned for data acquisition should be scheduled for these principal users of the system. Each principal user should participate directly in the data collection effort.

(2) Other Users

Communications systems which support multiple users frequently have "users of convenience" in addition to the principal users. These agencies typically employ few of the resources of the system, and the communications system is less critical to their operating capability. These users are frequently characterized by one or more of the following:

- Part-time dispatch or dispatch by other agencies
- Peripheral response requirements for emergency or disaster operations
- Secondary responsibility for the protection of life and property.

Frequently, data acquired from a principal user will also include data for one or more secondary users. For example, a police dispatch operation might also have full responsibility for the school bus radio system, the traffic sign repair units, and other part-time users of a local government radio system. Data acquired in this manner can be verified and/or reinforced by telephone or by other methods more time efficient than personnel interviews and individual inspections.

The amount of time and resources budgeted for the acquisition of data from less critical users of the system, and the identification of these second-tier users will vary with each project and local environment. The planner must consider the cost effectiveness of collecting data from these users within the framework of the project and the user relationships.

3. Plan for Data Acquisition

The most effective methods of data acquisition are based upon a well-conceived data acquisition plan. This plan will identify the elements of data to be acquired and the order and method of acquisition.

(1) Orientation Meetings

Before data collection is initiated in a multi-agency environment, orientation meetings with the user agencies should be conducted to ensure their support. These meetings will enable a review of the project objectives and should encourage the participation of the user agencies in developing the data survey package.

(2) Outline the Data Base Report

The data required (identified through consideration of the system objectives) can be further refined by developing an annotated outline for the data base report. This annotated table of contents will describe the type of data to be reported and the form in which the data will be reported. This will further define the data to be collected and the form in which the data will be collected from each agency. Data not needed can therefore be identifed and eliminated from the data collection effort.

(3) Develop the Data Outline

From the outline of the data base report each category of data can be further reduced to its component parts. This outline will serve as a checklist for the construction of questionnaires or interview guides to be used to acquire the data. Some of these data elements include the following:

- Operating Data
  - Dispatch operations
  - Command and control
  - Special operations - nuclear Civil Defense
  - Citizen access
  - Data system access
  - Interagency coordination
  - Maintenance considerations
- Technical Data
  - Licensed radio frequencies
  - Tone-coded squelch frequencies
  - Selective calling capability
  - Area of coverage
  - Transmission systems
    - Microwave
    - Telephone circuits
    - Radio relays
  - Traffic loads and traffic profiles

- Inventory
  - Base stations
  - Repeaters
  - Mobiles - vehicles
  - Portables
  - Computer-aided systems
- System deficiencies
  - Lack of coverage ("dead spots")
  - Channel overloading
  - Equipment deficiencies (obsolescence, maintenance, etc.)
  - Interference (IM, etc.)
  - Operator training
- Financial considerations
  - Current investment
  - Operating costs
  - Maintenance costs
  - Replacement costs

This check list of needed data elements will vary with the system objectives, the type of system being considered, and the size of the project.

The planner is obligated to develop the minimum list of data elements that will provide adequate support for the achievement of system objectives.

* * * * *

Having determined the type of data needed and having identified the elements of data needed for each data category, the planner is prepared to acquire the data and document it in a useful format.

III. METHODS TO ACQUIRE DATA

The methods of acquiring and recording the needed data will be determined by the size and complexity of the project. In general, the least time consuming and most cost-effective methods should be employed consistent with the needs of the project.

1. Determine the Data Acquisition Method

The method chosen for data acquisition must be suitable to the nature of the project and its size. The most common methods of acquiring data for a data base are shown in Exhibit B-1 along with a summary of advantages and disadvantages of each. These methods are discussed in the following paragraphs.

(1) Review of Existing Documents

The existence of documents containing the needed elements of data should be determined. These will provide the planner with baseline information around which the balance of the data acquisition effort can be planned. Useful documents to be examined should include:

- Earlier study reports
- Annual inventory documents
- Equipment purchase orders
- Annual budgets
- Previously prepared system configuration reports
- FCC radio station licenses.

The planner should verify the validity of these documents; the information may be out-dated.

(2) Questionnaires

The questionnaire is a traditional way of acquiring consumer data and is used with varying levels of success by communications system planners. The principal use of the questionnaire is for the acquisition of data from a large number of participants over a

EXHIBIT B-1
Data Acquisition Methods

Method	Advantages	Disadvantages
Questionnaire (mail)	. Wide distribution in less time . Low Cost . No interviewer bias . Likelyhood of thoughtful reply	. High level of refusal . Misinterpetation of questions is undetected . No control over quality of the informant . Written answers may be misinterpreted . Questions must be very carefully prepared . Follow-up required for no-response
Personal Interviews	. High yield from a 100 percent sample . Supplementary information can clarify response . Information is more likely to be correct . Informant can contribute additional relevent topics . Questions can be clarified . Refusal rate is low	. Costs are high for large samples . Transportation adds significantly to survey time . The block of interview time must be scheduled conviently for the informant . The interviewer can bias the results . Interview can tend to drift off-target
Telephone Survey	. Economical and fast . Commands greater attention . Refusal rate is low . Replies can be recorded for later transcription	. Data acquisition is limited to a few facts due to time factor . Lack of uniformity between telephone interviewers . Misinformation is hard to detect . Time may be inconvenient to the informant . Informant may not be the best qualified
Document Review	. Economical and Fast . Audit traceability . Data is recognized by other governmental functions such as budget control	. Information may be outdated . Construction of the data may not be obvious (for example, maintenance costs) . Data may only be defensible for its originally intended use

relatively short period of time. Although the distribution of the questionnaire may include 100 percent of the participants, the returns from a questionnaire survey are usually treated by sampling techniques due to the usual large number of refusals and the questionable quality of many of the returns.

(3) Personal Interviews

Personal interviews with user personnel are generally the most successful means of acquiring useful data. However, because of the cost and time factors of this method, the technique is usually applicable only for small to medium size programs involving a few user agencies. The interview appointments should be made in advance preceeded by a letter of introduction from higher authority, if possible. The probable collection of reports and documents from the informant that otherwise might not have been made available is an additional advantage of this technique.

(4) Telephone Interviews

These interviews are traditionally limited to the acquisition of limited amounts of data from numerous sources. It also has been used to acquire data from participants who are remote or otherwise difficult to visit for a personal interview. It is advisable that these interviews be preceeded by a letter of introduction from higher authority, if possible.

The telephone interview is also a rewarding follow-up to a questionnaire survey or an earlier personal interview. It can be used to update or fill in data and provides a continuing indication that the informant is an active participant in the program development.

* * * * *

The proper choice of a data acquisition method will enable the planner to prepare questionnaires or interview guides that will ensure the efficiency of the data collectors.

2. Develop Questionnaires/Interview Guides

The efficiency of data collection will be enhanced by the use of carefully prepared questionnaires or interview guides to correspond with the method of data acquisition that has been selected. In either case, the document should be designed to flow with the logic of the informant who is responding to the interrogation, not necessarily the format from which it is desired to record and report the data. For example, when questions are asked relative to the radio frequencies being used, these questions should continue into areas such as tone-coded squelch, selective calling systems, base-station locations, and other similar areas normally thought of when discussing radio systems and their characteristics. Data system access, the operation of the dispatch center, etc. should be addressed in other appropriate parts of the document.

(1) Questionnaires

In addition to developing the correct format as discussed above, preparing the questions is the most difficult part of developing a questionnaire. It is imperative that ambiguity be eliminated; each question must be tested repeatedly for ambiguity before the questionnaire can be considered ready for mailing. For example, questions such as "What is your main radio channel?" or "Do you use split shifts?" can have varying meanings and interpretations to different people. Failure to remove ambiguity can inadvertently invalidate large sections of the resulting data base.

The questionnaire should be as simple as possible to complete. Checking blocks is much preferred over essay type answers or any other kind of written response. If responses must be written, filling in blanks is preferred to essay answers.

Although the format of the questionnaire is arranged to simplify answering and therefore improve the accuracy of the response, it must also assist in extracting the responses for data reduction. The time spent in careful preparation of the questionnaire is rewarded during data reduction.

(2) Interview Guide

The purpose of the interview guide is to assist the interviewer in the orderly accumulation of data and provide a format for recording answers. The guide is used typically during personal interviews and telephone interviews.

The guide is constructed to enable a logical progress from one data type to the next data type while retaining the informant's train of thought. For example, the guide should not jump from the configuration of the radio system to citizen access traffic then back to the configuration of the radio system.

In the traditional use, the guide is used by the interviewer and not by the informant. The interviewer will record the answers to questions by filling in appropriate blanks on the guide. Questions will be phrased by the interviewer in accordance with the ability of the informant to answer.

* * * * *

The use of questionnaires and interview guides provides for the orderly collection of the data needed to develop the data base. When properly planned, the time lost in accumulating unnecessary data will be minimized.

IV. VERIFICATION OF DATA

It is inevitable that the data collected be less than 100 percent accurate. Therefore, the data should be verified when possible.

The verification of personal or telephone interview data is straightforward. A presentable copy of the completed interview guide or data report can be returned to the informant for review and possible correction. The confidence in the validity of data from written questionnaires can be established statistically.*

* For a more inclusive discussion of validation techniques for questionnaires, see Marten, Dr. Mildred, "Surveys, Polls, and Samples," pp. 486-510.

V. COMPILE THE DATA

The raw data from documents reviewed, questionnaires, and interview guides must be consolidated and reduced to a useful form for the data report.

1. Consolidation of data

Data from questionnaires and/or interview guides should be transferred to previously prepared data consolidation forms for manual reduction or, alternatively, entered into computer files for computerized data reduction. The files or data forms used for the consolidation of field data are formulated to be part of or assist in the preparation of the data base report that was previously outlined in Section II. Samples of data consolidation forms for different types of data are shown in Exhibits B-2, B-3, and B-4.

2. Reduction of Data

The data base report will be developed from the consolidated field data. The identity of the data will differ in accordance with the system objectives to be met for each project and in accordance with the size and complexity of the project. The consolidated field data will be reduced to the form needed by the data base report.

VI. DATA BASE REPORT

The annotated table of contents for the data base report was previously developed. The data base report should present all of the baseline data needed to develop the system concept and do so in a useful format. It should be prepared in a concise form easily interpreted by all participating organizations. It is important that the data be presented in a form directly responsive to the needs of the system designers; there should be no furthur need for them to reduce or interpret the data. Therefore, the type of data presented, the order in which it is presented, and the form in which it is presented is tailored to meet the unique needs of each project. There is no apparent standard outline for the data base report except that it contains all of the information needed by the system designer.

EXHIBIT B-2
Summation - Mobile/Portable Radios

AGENCIES	MOBILE RADIOS						PORTABLE RADIOS					
	Number of Channels						Number of Channels					
	1	2	3	4	8	Total	1	2	3	4	8	Total
. Law Enforcement												
- Pleasant Grove P.D.				17	2	19		3		10		13
- Sheriff's Central Disp.				73		73				24		24
- SLC Sheriff's Office				250		250				63		63
- Utah Highway Patrol				170	22	192				25		25
. Fire												
- SL City Fire Dept.		75				75	22					22
- SL County Fire Dept.	75					75	50					50
. Public Services												
- SL City & County Health	21					21	1					1
- SLC Public Works				110	30	140		3				3
- SLC Attorney				6		6						0
- SLC Surveyor		25				25		11				11
- SLC Building Inspection	20					20	1					1
- SLC Security	1					1	40					40
- SLC Aging Transportation	14					14	1					1
. Universities												
- Brigham Young Univ.	5			8		13	4			19	3	26
- Utah University			23			23			25			25
. Other												
- Utah DOT		50		150		200		5		10		15
- Fleet Management						2						0
TOTAL	136	150	23	711	32	1082	119	22	25	151	3	320

EXHIBIT B-3

Summation of Recurring Costs

AGENCY	MAINTENANCE COSTS	OPERATING COSTS			TOTAL COSTS
		No. of Dispatchers	Operating Hours	Cost	
. Law Enforcement					
- Pleasant Grove P.D.	$ 3,000	4	24	$308,235	$311,235
- Sheriff's Central Dispatch	2,088	8	24	118,945	121,033
- SLC Sheriff's Office	12,250	22	24	410,000	422,250
- Utah Highway Patrol	45,657	20	24	269,360	358,140
. Fire					
- SL City Fire Dept.	6,000	10	24	120,000	126,000
- SL County Fire Dept.	10,000	9	24	140,000	150,000
. Public Services					
- SL City & County Health	2,100	1	7-5	5,000	7,100
- SLC Public Works	12,000	5	24	70,000	82,000
- SLC Attorney	700	2		25,000	25,700
- SLC Surveyor	3,900	1	7-4	10,000	13,900
- SLC Building Inspection	1,300	2	8-5	22,000	23,300
- SLC Security	1,100	4	24	40,000	41,100
- SLC Aging Transportation	1,250	1	8-5	10,000	11,250
. Universities					
- Bringham Young Univ.	5,000	6	24	55,000	60,000
- Utah University	8,000	7	24	63,000	71,000
. Other					
- Utah DOT	19,000	2	8-5	33,333	52,333
- Fleet Management	750	0	-	-	750
TOTAL	$134,095	104		$1,699,873	$1,877,091

EXHIBIT B-4
Frequency Assignments

POLICE AGENCY	OPERATING FREQUENCY PRIMARY MHz	OPERATING FREQUENCY BACK-UP MHz	INTEGRITY 155.370	CONTROL STATIONS: BELLEVUE	BOONE CO	CAMPBELL CO	CINCINNATI AP	COVINGTON	ERLANGER	FLORENCE	FT THOMAS	KENTON CO	NEWPORT	CHANNEL ASSIGNMENTS FOR MOBILES/PORTABLES: BELLEVUE	BOONE CO	CAMPBELL CO	CINCINNATI AP	COVINGTON	ERLANGER	FLORENCE	FT THOMAS	KENTON CO	NEWPORT
BELLEVUE	155.070	453.575	●			●								1*		2					1		3
BOONE COUNTY	453.700		●							●					1	3			5	2		4	
CAMPBELL COUNTY	453.575	453.225	●								●		●			2					1		3
CINCINNATI AIRPORT	453.675	453.275	●														1-2						
COVINGTON	453.500	453.975	●					●								8		1-3	6		7	4	5
ERLANGER	453.525		●									●			4	5		3	1	6		2	
FLORENCE	453.150		●		●										2	3			5	1		4	
FT THOMAS	453.425		●			●							●			2					1		3
KENTON COUNTY	453.325		●		●	●		●	●						4	5		3	2			1	
NEWPORT	453.050	453.750	●								●					2		5			1	6	3-4

*VHF

The data consolidation forms should be designed to be used directly as exhibits in the data base report. The use of graphic presentation is also recommended wherever appropriate. Copies of the report should be provided to all contributors to the data base and all personnel concerned with the concept development.

It should be recognized that the data base, having been established, is subject to change. Regular updating should be planned. The files should have a regular program of audit and validation to ensure data accuracy and currency of the stored data. The extent of this activity will be dictated by the size of the program, the complexity of the system, the length of time the data base is to be used, and the elements of the data base that are critical to the system design.

APPENDIX C

UNIQUE 800 MHz TECHNICAL CONSIDERATIONS

APPENDIX C

UNIQUE 800 MHz TECHNICAL CONSIDERATIONS

The following notes are derived from empirical data arising from the installation of conventional 800 MHz land-mobile radio systems. The data is to be used as advisory information only, intended to highlight elements of 800 MHz system implementation that warrant special attention.

I. SYSTEM ENGINEERING

The following subsections refer to key elements of system design in which particular attention should be given to unique 800 MHz characteristics.

1. Propagation

Conventional engineering approaches* have been taken to 800 MHz propagation. The following conditions have been measured and observed from field installations of conventional 800 MHz systems:

- Path loss over "irregular"* terrain has been shown to result in an average 62 percent reduction in talk-out range and an average 66 percent reduction in talk-back range over conventional 450 MHz coverage for the same 1 μvolt and 2 μvolt coverage contours.

- Free space path loss appears to correlate closely with values predicted from conventional mathematical models.*

- Path losses in mountainous terrain correlate with path loss experience over "irregular"* terrain except that conventional diffraction analysis does not account for improvements (several dB over calculated signal strength) that have been observed in canyons or deep draws.

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* See for example: J.J. Egli, "Radio Propagation above 40 MHz over Irregular Terrain" Proc. IRE, pp. 1383-1391, Oct. 1957.

- Path losses by shadow effects have been observed as high as 30 dB with corresponding variations from the mean path loss.

- Scattering effects of 800 MHz are more pronounced than at 450 MHz but the resulting multipath characteristics of the received signal often fills in "holes" experienced at lower frequencies.

- Path loss of 800 MHz over water or swampy terrain correlates with conventional microwave techniques.

2. Noise Characteristics

The noise immunity of the 800 MHz frequency has been observed to be better by 3 dB or more than that of the UHF frequencies. More precise values in noise improvement will be developed as more test results become available. Man-made noise and atmospheric noise does not appear to adversely affect system performance. A low-noise design of the 800 MHz receiver has the result of improving the effective range of the system.

3. Penetration Characteristics

The penetration characteristics at 800 MHz can be approximated from 960 MHz microwave experience. Some of the considerations are:

- Building penetration predictions in the range of 10 dB to 20 dB per 100 feet of building structure, as developed through theoretic calculations, do not correlate with field tests; tests show several dB of better signal strength.

- Foliage penetration losses of 25 dB or more have been experienced at 800 MHz, losses similar to calculated microwave losses at 960 MHz.

- Penetration of large urban building concentrations is greatly improved over lower frequency penetration; the phenomenon appears to result from the scattering and multipath characteristics at 800 MHz.

4. Emission Considerations

The type of emission contemplated for an 800 MHz system configuration includes:

- Analog Voice or tone signaling - the 800 MHz system appears to be the equivalent to radio systems at lower frequencies.

- Digital voice or data - for land-mobile applications using omnidirectional antenna systems, there is concern over the adverse affect multipath will have on the bit error rates and/or error correcting codes or detection systems.

5. Ancillary Equipment

Ancillary equipment for the implementation of 800 MHz systems is readily available. Some of the ancillary items that need special attention include:

- Coaxial transmission cable displays approximately 50 percent to 60 percent more loss at 800 MHz than at 450 MHz. Cable smaller than 7/8 inch copper jacketed foam dielectric should not be used for base station applications; air dielectric cable displays less loss but will require pressurization to keep moisture out of the transmission line.

- The use of standard "N" connectors for RF transmission line systems is recommended; at the minimum, high-quality, low VSWR UHF connectors can be used. Assembly techniques should be of high-quality workmanship; losses resulting from reflected energy from poorly assembled connectors are much more severe at 800 MHz.

- Duplexers, isolators and hybrids are available for antenna subsystem design; typical insertion losses for duplexors is 0.8 dB per cavity leg; for isolators, 0.8 db per isolator; the typical insertion loss for a properly terminated hybrid is 3.5 dB.

6. Antenna Characteristics

Base station antennas with a gain of 7.5 dB are the most frequent choice. However, because there are special considerations at 800 MHz, actual field testing of alternate antenna configurations is the preferred way to determine the best antenna combination for a specific system. Some field observations regarding antenna selection include the following items:

- A base station antenna with an 8 to 10 degree vertical beam width and low angle of radiation appears to be a good compromise between gain and coverage. (Antenna gains greater than 7.5 dB provide too narrow a beam width for consistent coverage.)

- A mobile antenna with 3 dB gain has sometimes shown too limited an aperture for use in urban or deep canyon area; a quarter wave whip has a larger aperature and may give superior performance in this environment. The best mounting is in the center of a metal roof; mounting on the vehicle trunk will require careful placement to avoid the reflection from roof pillars and other structural members from causing destructive nulls and peaks in the horizontal radiation pattern.

- Due to ground effects, the minimum preferred height of the base station antenna above average terrain is approximately 200 feet; the antenna should not be side-mounted on the tower if top mounting is possible.

- FCC rules and regulations require that a directive antenna be used with a control station unless two or more repeater sites are controlled by one base station; corner relector antennas with 9.0 dB gain are available at 800 MHz.

7. Equipment Reliability

The reliability of 800 MHz radio equipment appears to be comparable to similar 450 MHz conventional equipment. Digital control equipment also displays conventional levels of reliability. The system design configuration should be analyzed for a series of failure modes to reveal vulnerable links in the interconnection of control functions and RF functions. If such vulnerable and critical links exist, redundancy of equipment and function should be considered if high levels of system reliability are required.

II. SYSTEM IMPLEMENTATION

Radio system implementation precautions typical of installations at lower frequencies are also applicable to 800 MHz. The following notes refer to areas which are more critical at 800 MHz.

1. Base Station Siting

Base station site selection is more critical at 800 MHz because of higher coaxial cable losses, smaller aperture of 800 MHz antennas, and the general non-bending characteristics of the 800 MHz wave front. One ideal site is the top of a steep mountain peak in the center of the coverage area far above average terrain and with near line-of-site coverage of the service area. Unless such a site is available, the following are considerations in evaluating alternate sites:

- Near line-of-site coverage of the primary service area.

- The equipment shelter should be close to the 800 MHz antenna.

- The antenna elevation should be great enough to avoid ground effects on the antenna pattern.

- The site should be prepared with a low impedance earth ground.

- The length of all RF transmission lines between the antenna(s) and the RF equipment should be as short as possible.

A high building in the center of the coverage area is also a preferred base station site with the provision that an adequate low impedance earth ground be available.

2. Mobile and Control Stations

The implementation of mobile and control stations has the same restriction on RF transmission line length as does the base station. Lines of any appreciable length for control stations should be no less than 7/8 inch copper jacketed foam dielectric while those of mobile stations can be 1/2 inch flexible copper jacketed foam dielectric. Air dielectric RF cables should not be used because of the need for pressurization.

At 800 MHz, external noise is considered to be quite low, but mobile installations in particular should guard against noise entering the system through the vehicle ignition or electrical subsystems.

Particular attention should be paid to the RF transmission line. If the attenuation of the line is high, the signal-to-noise ratio at the front end of the receiver tends to be low. This can not be corrected by RF amplification because the line noise will be amplified along with the signal.

III. INSTALLATION AND MAINTENANCE

The installation and maintenance of a high technology 800 MHz system will require attention beyond the levels afforded lower frequency sophisticated systems.

1. Technician Skill Levels

A trunked radio system requires that the transmission characteristics of each radio channel in a multiple channel repeater type system be nearly identical; there should be no significant difference in the performance of any channel selected. This requires skill levels beyond those normally expected of the installation and maintenance technician.

The installation and maintenance of coaxial cables and fittings at lower frequencies has typically been a continuous quality problem. At 800 MHz, coaxial line fittings resulting in a higher than normal VSWR will look like an open circuit to 800 MHz equipment. The electrical length of the coaxial cable assembly at 800 MHz can be critical. The insertion of test instruments such as wattmeters into the cable assembly can detune the transmission line.

2. Specialized Test Equipment

The difficulty of establishing effective radiation patterns from 800 MHz installations at base stations, control stations, and mobile stations coupled with the need for a standard level of performance for all channels of a trunked system indicates the need for specialized test equipment and the skills to operate that special equipment. Special equipment will be required to complete an acceptable installation. Special portable equipment will be required for periodic maintenance.

3. Spare Parts Availability

Much of the RF and digital hardware in an 800 MHz trunked or cellular system will be non-standard in terms of off-the-shelf availability. There must be assurance that an adequate supply of replacement parts and modules are available from the supplier. This availability is needed over the expected life of the equipment.

4. Maintenance Shop Availability

The supplier and/or operator of the 800 MHz system should have prompt access to a maintenance shop staffed with technicians of adequate skill levels. Quick reaction maintenance support is a requirement.

IV. GENERAL CONSIDERATIONS

It should be specified that the supplier of a trunked or cellular 800 MHz radio system provide complete training to the operating and maintenance personnel of the base stations, mobile stations, and control stations. Training will include the technical aspects of the system and its digital control subsystems.

FOREWORD

The recommended elements of the Statement of Work are described as a major part of the System Procurement subsection in Section III of the SIP Guide. This appendix is intended as a topical outline of a typical Statement of Work (SOW) for quick reference by the planner or system procurement manager. The SIP Guide provides supporting material for this topical outline.

The following outline adheres to the recommended order of topics for a high technology system SOW. The planner or system procurement manager is cautioned to employ only those elements of the outline which relate to the specific procurement and which can be accurately evaluated or measured.

APPENDIX D

STATEMENT OF WORK

I. INTRODUCTION

The Introduction to the Statement of Work (SOW) should provide a general overview of the project to enable a better understanding by the responders. The key elements of this section are outlined in the following subsections.

1. Background of the Project

A brief historical description of the origin of the procurement and the constraints imposed on the design.

2. Objective of the Procurement

A brief discussion of the main system objectives to be achieved by the procurement.

3. Scope of the Procurement

A basic and brief outline of the hardware, software, and services that are being purchased. These may include, for example:

- Hardware
- Software
- System Design
- Installation
- Testing
- Training
- Maintenance.

II. INSTRUCTIONS TO BIDDERS

This section of the SOW will provide the bidders with all the information needed to respond correctly to the bid request.

1. Procurement Schedule

The schedule time and dates for responding to the bid request will include:

- Time and place of the pre-bid conference
- Time and place bids and proposals are due
- Bid and proposal opening time, date, and place
- Proposed contract award date
- Expected date of contract completion.

2. Authorized Contracts

The persons who are authorized to respond to bidders' requests will be identified prior to bid opening. These may be restricted to the:

- Procuring officer
- Technical consultant.

The statement should be made regarding how the issues raised by these contacts will be reported to the other bidders.

3. Bid and Proposal Requirements

Each of the items to be submitted as part of a responsive bid will be defined. Any limitations should be included in the description. These items would include, for example:

- Itemized cost proposal
- Technical proposal
- Management proposal
- Provisions for alternate proposals
- Proposal limitations regarding page count, standardized forms (cost proposal), proposal size, unnecessary artwork, and number of copies to be submitted.

4. Qualifications of the Bidders

The contractor for a high technology system must be qualified, technically and financially, to complete the required work. These qualifications should be expressed in the SOW by requiring reasonable responses to limits imposed on:

- Bidders' facilities and financial resources
- Performance history in terms of references and a list of similar and recent contract work
- Support facilites such as field maintenance shops, training facilities, and spare parts replacement depots
- The quality and availability of personnel for management, supervision, and technical staff.

5. Proposal Evaluation Criteria

Criteria should be established for the comparative evaluation of:

- Technical proposals
- Cost proposals
- Management proposals.

These criteria should be clearly defined in the SOW so that each bidder will understand the emphasis placed on the requirements of the RFP.

6. Contract Award

The SOW will identify the type of contract to be awarded the successful bidder whether or not this contract will be awarded without pre-contract discussions.

7. Indemnification

The purchaser should require indemnification against damages imposed through intentional or unintentional acts of the contractor. High technology system procurements will need indemnification against the improper use of patented items or processes. All procurements which include services such as installation and test will be well advised to require indemnification from damages resulting from the actions of contractors' employees or agents.

8. Titles and Rights

Rights of the purchaser and ownership of titles will be clearly defined by the SOW. These items include statements related to:

- The transfer of title to equipment and software
- Rights to data and software developed or provided as part of the contract
- Rights and title to the submitted proposals
- The right to reject proposals
- The right to negotiate with any bidder
- The right to cancel negotiations or the contract.

Legal counsel should be consulted for the scope, content, and wording of this subsection of the SOW.

9. Bonds, Insurance, and Warranty

Each governmental entity will have its own limits for, and description of, the bonds, insurance and warranty provisions for contractor provided material and services. Frequently there will be state regulations which also must be adhered to. These requirements will provide for:

- Performance bonds
- Workman's compensation
- Comprehensive liability insurance
- Warranty on workmanship and materials.

The purchasing department of the major governmental agency included in the program will provide counsel as to how these requirements are to be included in the SOW.

10. Costs of Proposal Preparation

The SOW should state clearly that any costs related to the preparation of bids or proposals can not be included in the proposed cost of the project or billed back to the purchaser in any manner.

11. Contract Disputes

At the option of legal counsel, the SOW may indicate the means by which the governmental agency resolves contract disputes. This will be a function of the governmental body and will not be an option of project management. These provisions may include:

- The procedure and method of resolving contract disputes
- Termination of contracts for cause
- The assessment of liquidating damages
- The identity of the court of jurisdiction.

12. Applicable Federal/State Laws and Regulation

When State or Federal laws/regulations affect the system design, its operation, or allowable use, these laws or regulations should be identified in the SOW.

III. SCOPE OF WORK

This section of the SOW defines the items of work expected of the contractor; the specific tasks required by the contractor are described in detail.

1. Services to be Provided

High technology systems will require professional services to be performed by the system contractor in addition to the delivery of hardware and software items. Typical services to be provided are:

- System design which can include system engineering, radio propagation engineering, software development, and hardware development.
- Installation and debugging of hardware and software.
- Assistance in procuring required licenses and permits.
- Developing and conducting performance tests and acceptance tests.
- The preparation of sites and facilities which can include construction, HVAC, emergency power, lighting, installation of utility services, etc.

2. Deliverable Items

Each deliverable item should be identified in the SOW. Deliverable items include hardware, software, and services. The list will be unique to the complexity of the system to be procured. However, there will be some items common to all lists such as:

- Each item of electronic or radio hardware
- Each item of computer software
- Maintenance support
- Spare parts and spare module provisions
- Towers, buildings and other structures
- Manuals and documentation such as test plans, test procedures, maintenance manuals, operators manuals, user manuals, training aids, installation drawings, and test reports
- Progress reports and deficiency reports.

3. Delivery Schedules

Each deliverable item should be supported by a delivery schedule. The SOW will require a formal and contractually obligated schedule for:

- Each item of electronic or radio hardware
- Each item of computer software
- Each tower or building
- The completion of all facility preparations
- Delivery of all manuals and documents
- The time and place of technical progress reviews
- The delivery of reports including progress reports, test reports, discrepancy reports, and the final report or acceptance test report.

IV. SYSTEM SPECIFICATION

The system specification is a complete technical system description which includes the system performance, system interfaces, and system configuration. It places technical limits on these parameters and adds reliability and/or maintainability requirements where appropriate.

1. Hierarchy of Specification and Standards

Industry or regulatory specifications or standards frequently apply to the specification of a system. These should be identified. The hierarchy of these documents, as they apply to the system specification, should be defined so that conflicts between them can be resolved.

2. System Description

The system description includes the configuration of the system elements and their interconnection with each other. It is recommended that this be done graphically with supporting written clarification. The system description is derived from the system concept design.

3. System Interfaces and Supporting Services

The means by which the system interconnects with the world outside of the system should be fully described. These interfaces are relatively unique to each individual system, but some key interfaces will include:

- External communication systems such as mobile radios, private telephone systems, data processing, digital data systems, alarms, microwave transmission systems, and similar facilities
- Utility systems such as public access telephone systems commercial power systems, and water supplies
- Emergency operations such as emergency power services, fire protection, emergency medical services, and civil disaster prevention operations.

4. System Software

The system specification will include a complete description of the operations software and the applications software required to provide the needed system performance.

5. System Operation and Performance

The specification of system operation and performance is tailored to meet individual system requirements as developed in the system concept. Typically these specifications will include a complete description of:

- The functional modes of system operation for routine system performance, emergency system performance and allowable fail-safe or degraded levels of performance.
- The calculated levels of personnel staffing for the operating staff, maintenance staff, and system management.

6. Expansion Requirements

Frequently, limitations on funding or other resources will prevent the initial implementation of a sophisticated system from realizing the full potential of system operation, scope, and performance. When these expansion requirements are part of the initial system procurement, they must be fully described in the system specification.

7. System Licenses and Approvals

High technology systems may exceed the apparent limits of Federal or state licensing regulations and extraordinary procedures may be needed to acquire the necessary permits or licenses. These requirements should be clearly defined in the system specification. They will be unique to each specific system configuration and intended operation.

V. EQUIPMENT SPECIFICATIONS

The equipment specifications define the quality and performance characteristics of each item of hardware and software needed to meet the system specifications. The identity of each hardware and software item is derived from the system configuration diagram which was developed as part of the system concept.

1. General

This subsection of the equipment specifications accumulates all items of the individual equipment specifications requirements that are common among all items of equipment or software. It also defines the quality and quantity of each item of hardware and software that is required to meet the system configuration. Typical items that would appear under the general heading are:

- Applicable industry standards or publications and their hierarchy for this program
- Standard environmental conditions such as temperature, humidity, primary power, vibration, shock, dust, and dirt
- Deliverable equipment lists showing the quantity required of each item including spares
- The required level of quality and workmanship for each hardware item.

2. Individual Item Specifications

Each equipment item will have an individual technical specification which reflects its construction and performance as required to meet the system specification. These are derived individually from the system performance requirements and should be no more severe than those needed to meet the system performance specifications. Software specifications are typically combined with the equipment specification for the computer subsystem or the switching subsystem in which they are resident.

END