PLANNING GUIDELINES FOR LAW ENFORCEMENT TELECOMMUNICATIONS SYSTEMS

National Criminal Justice Information & Statistics Service
Law Enforcement Assistance Administration
U.S. Department of Justice

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Law Enforcement Assistance Administration

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FOREWORD

On May 6, 1974, the Law Enforcement Assistance Administration (LEAA) of the U.S. Department of Justice issued a grant in the amount of $592,994 to the Associated Public-Safety Communications Officers, Inc. (APCO) to conduct a review and assessment of the Law Enforcement Telecommunications Planning activities of the 50 states and the District of Columbia. The study also included a review of the law enforcement telecommunications planning within the cities of New York, Chicago, and Los Angeles. It was known as Project 13.

A second objective of the grant was the development of a set of planning guidelines for use by local-level law enforcement personnel engaged in planning for law enforcement telecommunications systems.

APCO was established in 1934 as a voluntary association of public-safety communications officers. Its membership has been in the forefront of the development, implementation and operation of public safety communications and information handling systems since its inception, and has been deeply involved in programs throughout the public safety field. The development of the State Planning Agency (SPA) concept under the "Omnibus Crime Control Act of 1968" (hereafter called "the Act") and the resulting mandated statewide comprehensive law enforcement plans have, therefore, had great impact on its members. Further, the APCO membership has been intimately involved in the implementation of these plans.

The modernization of the nation's law enforcement agencies that has been stimulated by the Act has imposed increasing dependence upon new technologies, particularly in the field of telecommunications. This reliance upon more complex, higher speed and wider area communications systems has brought with it new sets of problems.

Telecommunications, as defined by APCO Project 13, are land mobile law enforcement voice and data communications systems including their dispatch, command and control facilities wherein the terminals of such systems are located. The term includes the interfaces of such systems with those of common carrier, wide-area criminal justice information and other public safety communication systems but not the total complex of these systems themselves.

Telecommunications are, by their nature, complex technological systems. The engineering, system design, integration and procedural skills needed to implement and operate such systems are highly specialized and not routinely inherent in the criminal justice profession.

These systems follow physical laws, not political boundaries; therefore, systems design and operation cannot be effected unilaterally. Interagency cooperation requires interagency planning. Technical oversights or undisciplined operation within one system can cause destructive interference in another. Failure to properly plan a system can result in its technological isolation and the inability to reap the benefits of wide-area information flow and interagency communications.

Recognizing the role of telecommunications in the modern law enforcement environment, LEAA, charged by Congress with the responsibility for administration of the Act, chose APCO to assess the present status of telecommunications planning by the SPAs and to develop guidelines for the assistance of those at the municipal, county and state level involved in the development of telecommunications plans.

The specific objectives of this project were:

- *To conduct a detailed survey of the SPAs of the 50 states and the District of Columbia.* In addition, thy law enforcement telecommunications planning activities of the cities of New York, Chicago and Los Angeles were to be surveyed to offer additional insight into the planning activities of these agencies. APCO selected a consulting contractor, Booz, Allen & Hamilton Inc., to participate in this project, and teams of APCO and contractor personnel conducted the required surveys by personally visiting the SPAs of the states and cities.

  To ensure complete insight into the SPA telecommunications planning activity, Divisions of Communications (DOC) were surveyed in those states where such divisions exist, and where their activities either contribute to or provide a part of the SPA's telecommunications planning, such information was incorporated to provide a completely comprehensive view of the total planning picture in that state.

- *To prepare an analysis of the data collected.* These surveys yielded a massive volume of data. Approximately 180 questions were asked of each SPA and of each DOC. All telecommunications grants issued between July 1, 1971, and January 1, 1975, a total of 7,686 grants, were reviewed for content, scope, objectives and application. To make the content of this volume of data comprehensible, an analysis of the data was performed. This analysis involved entering the survey results into machine processing systems and selecting the various matrix ordinates and abscissae necessary to yield insights into the implications of the results. The results of this analysis provided insight into national trends in law enforcement telecommunications development and a factual picture of the resources being applied to the development of the telecommunications portions of the statewide comprehensive plans. This analysis shows the scope

and contents of these plans, and the objectives and methodology of the plans. It also yields information regarding the overall impact of the activities, objectives, and execution of grant programs since July 1971.

To develop a set of guidelines for use by law enforcement telecommunications planners at the state and local level. The present approaches to telecommunications planning at local and state levels are almost as varied as the number of practitioners. The third task of Project 13 was to synthesize, from the data and experiences acquired during the survey and analysis phases of the project, a set of planning guidelines that would provide a basis for a standardized approach to telecommunications planning. The objective of these guidelines is to ensure a rational, orderly process of plan development, from identification of goals and objectives through implementation to evaluation. In addition to ensuring that all relevant factors are considered in the development of plans, these guidelines are intended to provide a channel of communication between the developer of the plan and the reviewer of the plan. When these guidelines are accepted, the planner will know what steps the reviewing agency will be seeking in the plan, and the reviewing agency will know what items should be addressed in the plan. To assist in their use, the guidelines contain a model situation and the plan resulting from that situation as an example of the development of a municipal-level law enforcement telecommunications plan. The guidelines also contain checklists against which a reviewer can compare the plans he receives for completeness and comprehensiveness.

The management and execution of a project of this scope has relied upon a time tested and proven procedure used by APCO in many of its other project series. Because of the breadth of skills represented by its membership and their geographic dispersion, full use of APCO's abilities is best accomplished by selecting members with outstanding qualifications in the various disciplines needed and assigning them to working task groups. These voluntary task group members met periodically throughout the project to contribute to the end product during its various phases of development.

The specific approach used in Project 13 was to have the consulting contractor, Booz, Allen and Hamilton, develop drafts of the various deliverable documents. These drafts were provided to the task group members several weeks before task group meetings. After this individual pre-meeting review, the task groups met with the contractor and provided inputs to the final documents, both from an overall standpoint and on a page by page basis.

APCO established three task groups to accomplish Project 13. Task Group I was comprised of the Board of Officers of APCO. It received assistance and advice from APCO's legal counsel, a representative of the International Association of Chiefs of Police

(IACP), the APCO Executive Secretary and the Project Director. This group provided overall project policy guidance and exercised approval authority on each phase of the program.

Task Group II represented the technical and professional skills of the APCO active membership. Nine highly qualified professional communications specialists from various parts of the United States met for days at a time to provide the professional and technical insights upon which this report is based. During the survey phase of this project, the APCO survey team members who participated at the state level also reported to this task group.

Task Group III was composed of six commercial members of APCO. These volunteer representatives of the commercial interests of the law enforcement telecommunications profession followed the same procedures as Task Group II, thereby ensuring that the knowledge and experience of all aspects of the law enforcement telecommunications community were fully represented.

Mr. J. Rhett McMillian, Jr., APCO Executive Secretary, provided overall program supervision of the execution of the project. Mr. Donal Kavanagh acted as the project manager.

LEAA administration of Project 13 was provided by Mr. S.S. Ashton, Jr., and Mr. William Bailey, systems specialists in the Systems Division of headquarters of LEAA, Washington, D.C.

ACKNOWLEDGEMENTS

Major contributions to Project 13 were provided by the following individuals.

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The number of dedicated and energetic people who participated in this project is too great to fully recognize all that are so deserving. The APCO survey team members, the SPA executives and planners, the state DOC representatives and the LEAA Regional Offices personnel, all of whom gave so unstintingly of their time, their knowledge and their cooperation, merit the utmost of appreciation for their contributions. Without their efforts, cooperation and understanding, this project would have been impossible. To each one the entire law enforcement telecommunications community owes a debt of gratitude.

Donal D. Kavanagh
Director, Project 13

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I. INTRODUCTION

I. INTRODUCTION

These guidelines are designed to provide a working tool for personnel involved in the planning for and implementation of law enforcement telecommunications systems. They are the result of a survey of the telecommunications planning processes and activities of state-level planning agencies in the 50 states, the District of Columbia and planning agencies in the cities of New York, Chicago, and Los Angeles.

Throughout this document the term telecommunications is defined as land mobile law enforcement voice and data communications systems including their dispatch, command, and control facilities wherein the terminals of such systems are located. The term includes the interfaces of such systems with those of common carrier, wide-area criminal justice information, and other public safety communications systems but not the total complex of these systems themselves.

1. PURPOSE

The purpose of these guidelines is to provide the user with a description of the factors requiring consideration, evaluation, coordination, and resolution during the development of workable law enforcement telecommunications systems. They are intended to provide reference material for use by planners, managers, and reviewing authorities. They provide a means to comprehensively review plans and designs; they are not, however, intended to describe or substitute for the engineering analysis that may be required.

These guidelines will not presume to tell the user what decisions he should make. They are intended to show him which areas require decisions and to guide him in obtaining a basis for his decision.

The guidelines are, in effect, a recommended approach to problem solving – a step-by-step procedure to be followed through the planning process. The guidelines are versatile; they show the user how to adapt and tailor each step of his planning to the scope of his task. With this planning tool, proper objectives can be identified, planned for, and attained. The guidelines also include a checklist for use both by those who develop plans and by those who review plans to determine whether or not the plan reflects real requirements, if the equipment to be used will meet system specifications, that the plan has been properly coordinated, and that it includes all system components needed for successful operation.

2. CONTENTS

The guidelines are divided into twelve chapters. Each of these chapters considers an identifiable portion of the overall planning task. Within the limits of possible completeness, each chapter is designed to stand alone. But for a plan to be credible, it must have all the listed elements. A professionally complete plan must show that all the important elements have been recognized and the extent of their application rationally determined.

The organization of these guidelines follows the procedure for orderly plan development. First is a recommendation and plan for the establishment and application of a data base and its tailoring to the needs of the using organization and scope of the plan. This is followed by a discussion of the recognition of goals and the identification of objectives. Requirements are developed from these system objectives. Described are the means of using requirements as the foundation blocks on which the planning decisions must be based. From this combination of requirements and the data base (the future need versus what is presently available) is developed the beginning rationale for a system concept.

The principal elements of a system design are covered. These are listings of considerations, the application of which must be weighed by the designer and determined by his needs and expertise. The considerations include those subjects that must be addressed if the final product is to perform as a total system. The ways in which they relate to each other are suggested so that the system designer can schedule, quantify, configure, or reject as he deems appropriate.

Once the system is designed, its functional elements must be defined and specified. Approaches to this task are described with observations on the applicability of the different types of specifications, the topics that require specifications and the ways in which these specifications can be developed.

Based on the foregoing, the means for preparing a system implementation plan are presented. The contents of such a plan are outlined, and its role in guiding and monitoring implementation progress is described. The application of the plan to the integration of activities by related agencies is also described.

Techniques, principles, and general requirements associated with the procurement process are discussed. These principles are designed to have universal application, and they are not intended to be a substitute for local procurement policies and regulations. Rather, they provide guidance relevant to the applicability of various procurement techniques to the unique problems of telecommunications systems.

The final chapter describes needs, techniques, and responsibilities associated with conducting the evaluation phase of the telecommunications project implementation.

3. FORMAT

The format of these guidelines has been designed for ease of use. An item-by-item checklist is incorporated at the end of each chapter to assist the reader with his review of each factor with the descriptive material close at hand.

As an example, a hypothetical plan is presented in Appendix A to illustrate the application of the steps described.

II. THE PLANNING PROCESS

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It is appropriate to introduce a planning guideline with a definition of the word "planning." It is doubtful whether any word in modern usage is more misunderstood than this word.

Planning is defined as an analytic process which includes an assessment of future needs, the determination of desired objectives in the context of these needs, the development of alternative courses of action to achieve such objectives, and the selection and implementation of a course of action from among the alternatives. (Ref. 1)

The approach to planning based upon the above generic definition will be tailored to the specific needs of telecommunication system planning. Two levels will be considered in this planning process:

- Long-range planning
- Short-range planning

Long-range implies a multi-year program involving several projects or phases of implementation. Short-range planning, on the other hand, implies a project having a clearly visible completion date within a relatively short time period. It will be shown that these two levels of planning are mutually interactive.

The fine art of planning is to forecast long term needs and time the solutions to those needs. Premature planning can be avoided by using the data base as the source of factual data needed to define problems that need long-term and short-term solutions.

1. LONG-RANGE PLANS

The approach to long-range planning is a series of conceptual phases interrelated to one another in a definitive order. (Ref. 2) A typical description of the long-range planning process is the following eight-step classification of phases which is also shown graphically in Figure 1.

- Identify the problem
- Establish goals and objectives
- Establish planning assumptions

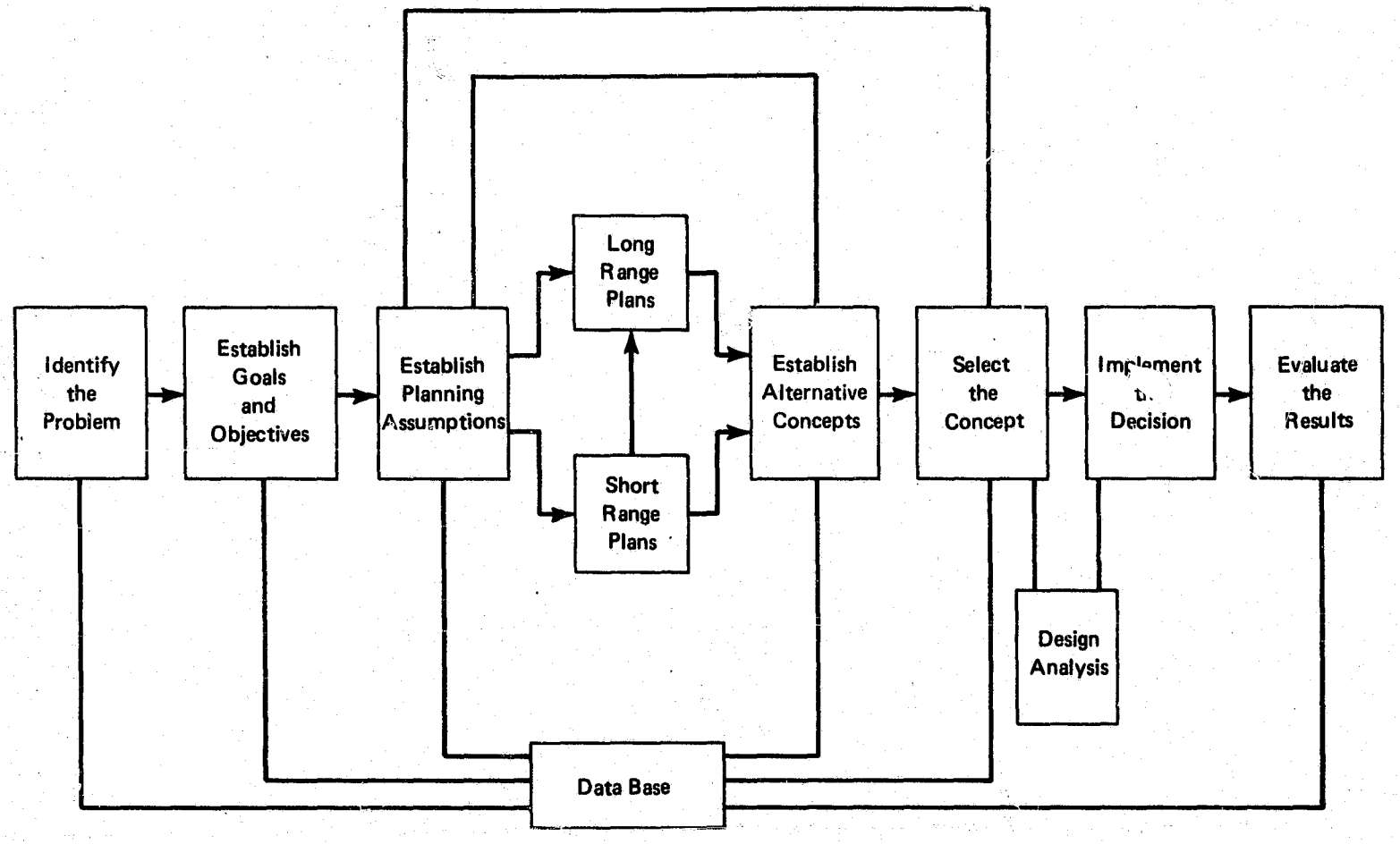

FIGURE 1
Basic Planning Process

- Determine alternative courses of action
- Evaluate the alternative courses of action
- Select a course of action from the alternatives
- Implement the selection
- Evaluate the results in terms of the problem.

These phases are mutually dependent and Figure 1 shows feedback at several levels using a data base as a data library. In the following paragraphs, each phase of the planning process will be specifically related to telecommunications system planning.

(1) Identify the Problem

The first step in planning is to find the real problem and to define it. To arrive at a definition of a problem, the planner must examine all of the facts bearing on the situation and find the critical element that has to be changed. A symptomatic solution is seldom adequate and, in fact, could involve unnecessary expenditures with little or no tangible improvement. The data base should provide needed assistance in the factual definition of the problem. For example, failure to provide adequate radio coverage may not always mean the relocation of the base station and antenna tower. Faulty mobile equipment maintenance or system degradation due to age have sometimes been the basic cause of the problem.

(2) Establish Objectives and Requirements

Long-range plans are based upon the attainment of overall goals which tend to be general and timeless. These goals are more specifically defined by sets of objectives and requirements that lead to the attainment of a goal. In long-range telecommunications system planning the emphasis is on multi-jurisdictional coordination, state or national objectives, multi-year implementation, and broad based system configurations. The time factors involved in long-range planning often call for supporting short-range plans to bring about total implementation. In establishing the dimensions of the objectives and requirements, the data base is constantly referred to for factual inputs.

(3) Establish Planning Assumptions

To justify a long-range plan, there must be evidence to support the assumption that there is a need for the plan and that a successfully implemented plan will satisfy that need. The data base should provide evidence of need, as will comprehensive state

(6) Select the System Concept

This major decision point will be indicative of the success of earlier phases of the planning process. The emphasis is upon choosing the alternative that offers the better combination of acceptability, system effectiveness and cost of ownership. To reject all alternative solutions and to reidentify the problem and the planning assumptions is also an acceptable solution at this point. For example, when the funds available are known and no alternative solution falls within the limits of those funds, the planner should readdress the problem in terms of adjusting the priorities.

(7) Implement the Decision

Implementation of the chosen alternative concept includes a series of planning decisions and the management structure to make those decisions. Some of the major decisions will include the following:

- *Procurement Specifications* – The decision is between system function specifications, system performance specifications, system design specifications and hardware item specifications.

- *Procurement Method* – The decision is between contracting for a "turn-key" operation, contracting for system integration, or retaining full system integration responsibility within the procuring agency and purchasing only the system hardware and software items as needed.

- *Facilities* – Decisions may have to be made between the use of existing facilities for the system, the use of modifications of existing facilities, the use of newly constructed facilities, or the use of a combination of these alternatives.

- *Personnel*–Decisions may have to be made regarding the job descriptions relating to the new system, the retraining of existing personnel, and the hiring and training of new personnel. Decisions may be required regarding the salary levels of all system personnel and the employment benefits to be offered.

These many facets of implementation of long-range plans imply an organized management structure to cope with the wide varieties of implementation problems. Such a structure would include, for example:

plans or other regional planning documents. The availability of adequate financial and physical resources over a reasonably long period of time must be assumed. It must also be assumed that the changes brought about by implementation of the plan will be acceptable to the user agencies.

These assumptions, made early in the planning process, may change as outputs from the planning process become available. Any change in the assumptions will require review of all previous planning affected by these assumptions. The plan should be designed to accept these feedbacks and allow for necessary alterations.

(4) Determine Alternative Courses of Action

It should be a rule of planning to develop several alternate solutions to every problem. The tendency is to plan only for the extremes and to hope that a full range of solutions have been covered because the extremes have been identified and stated. A planner should seek as wide a configuration of alternative solutions as time and funds will allow and should be receptive to new alternative solutions for the life of the planning process. Some of the more applicable alternatives will come from feedback of the output from later planning phases.

(5) Evaluate Alternative Courses of Action

The evaluation of alternative solutions is based first upon the satisfaction of the need. Previous planning phases will have identified the long-range problems, objectives and requirements to be met, and each alternative plan should be evaluated first in these terms. In telecommunications systems this becomes a measure of system effectiveness in meeting radio coverage needs, reducing field response times, and in similar requirements. Cost also becomes an important factor in the evaluation and must be traded off against system effectiveness.

Acceptability of the solution by the system users should also be an important factor in the evaluation. A telecommunications system will usually have a critical man-machine user interface which must be satisfied. An aggregate of existing laws, regulations, standards and plans form the environment in which the planned system must operate and be evaluated.

The planner may find that the factual evaluation of alternatives will sometimes modify earlier planning assumptions.

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These many facets of implementation of long-range plans imply an organized management structure to cope with the wide varieties of implementation problems. Such a structure would include, for example:

- *Project Management* – The control of and reporting on financial status and work progress including the generation and maintenance of the work breakdown structure, management control systems, work schedules and financial schedules for all facets and levels of the project

- *Engineering Design* – The preparation of technical specifications for systems and equipments, the delineation of testing programs to assure conformance to the specifications, and the technical evaluation of the system design to assure that system objectives and requirements are met

- *Procurement* – The contracting for all materials, facilities, hardware, software and services needed to implement the system, including construction contracts and consultants

- *Legal Counsel* – Review of contracts, execution of leases, acquisitions of real estate, licenses and the review of applicable state laws, federal laws and local ordinances.

(8) Evaluating the Results

An objective measurement must be conducted to determine whether the plan as implemented was successful in meeting the need, the goals, the objectives and the requirements. The data base will provide the system performance as it was prior to the change and the system test results can be compared with this basic data. The system evaluation parameters must be planned at the time the alternative system concept was chosen. Evaluation criteria are measured at planned points within the system implementation phase of the plan. Evaluation criteria tests may continue well after the telecommunication system has become operational. As an example, requirements to reduce law enforcement agency response time can only be evaluated over an extended period of time after the system is fully operational.

A well organized long-range plan may, for reasons beyond the planner's control, become a series of short-range plans leading to the same conclusion but on a different time base. This interrelation between long-range plans and short-range plans will be further amplified in the following section. It is also evident that the two types of plans should follow the same series of phases. Some of these basic planning considerations for both long-range and short-range plans are shown in Table 1.

Table 1
Planning Considerations

Significant Considerations \ Elements of the Plan	Identify the Problem	Objectives and Requirements	Planning Assumptions	Establish Alternative Concepts	Evaluate Alternative Concepts	Select the Concept	Implement the Plan	Evaluate the Results
The projection of future needs is confirmed	x	x	x					
The need to change is supported by fact	x	x	x					
The need to change is acceptable to the user		x	x	x				
The planning for change is not premature			x	x				
The present system can be defined factually	x		x	x				
The planned change can satisfy the need		x	x	x	x	x		
Resources are available to generate a plan			x	x	x	x		
The planning process will have dynamic feedback			x	x	x	x	x	x
Authority to make planning decisions is clear			x		x	x	x	x
Resources are available to implement the plan			x			x	x	
Results will be measurable quantities							x	x
Measurable results are comparable to established needs		x						x

2. SHORT-RANGE PLANS

It can be said that a long-range plan consists of a series of short-range plans. The implication is that a short-range plan of more limited scope to be completed within a shorter time cycle should receive the same benefit of organized planning as the broader scope long-range plan.

(1) Identify the Problem

The problem to be solved by the short-range plan is usually more visible to the planner than is the problem that leads to the long-range plan. However, a symptomatic solution is still suspect and all of the facts that contribute to the situation should be examined to identify the critical elements. However, the short-range plan need not be designed to solve a problem by itself; it may be designed to move the elements of the problem into position for a longer-range solution. Such an example might be a plan to move a bill through state legislature that would enable the later planning of a multi-county, multi-agency public safety dispatch center.

(2) Establish Objectives and Requirements

Short-range plans seldom address broad public safety goals. The short-range plans are usually more project oriented. The end result of a short-range plan should be highly visible to the planner and user and the attainment constrained within reasonable time limits. The goals and objectives of the associated long-range plan can provide short-range plan objectives and requirements. However, short-range plans may be designed to complete limited projects and, as such, may stand alone and have their own objectives without being a part of any higher order of planning.

Project plans are usually short-range plans. Projects such as preparing a long-range planning document, completing a telecommunications system design, and preparing a system evaluation model to be approved are samples of short-range plans that support long-range plans. A project plan to replace a destroyed antenna tower could be an example of a stand-alone short-range plan.

(3) Establish Planning Assumptions

Short-range planning should proceed on the basis of planning assumptions. In the previous example of a multi-county dispatch center it could be assumed that the bill would pass the state legislature and a plan could be implemented at once to

obtain the cooperation of the municipal and county agencies and have the necessary resolutions passed by the governing bodies. Assumptions regarding funding and user acceptance are similar to, but smaller in scope than those of long-range plans. It is also evident that feedback from later events can change the planning assumptions made and can alter or even cancel the short-range plan. When a planning assumption changes, the effects on all aspects of the plan should be evaluated.

(4) Determine Alternative Courses of Action

It is no less important in short-range planning to develop several alternative solutions. If only one solution presents itself, the planner can assume that the research leading to the identity of the problem was incomplete and that the critical elements that led to the need for planning were not adequately explored. A sound planning assumption to be used in this phase is that, there is always more than one solution and always more than one path to a solution.

(5) Evaluate Alternative Courses of Action

The evaluation of short-term planning alternatives follows the rules for long-range planning as discussed in previous paragraphs. The degree to which objectives and requirements are met, the level of system effectiveness, the cost of ownership, and the acceptance of each alternative should be evaluated. The scope of the evaluation is usually smaller and the uncertainty existing in the evaluation points and the cost figures is usually less than is the case of most long-range plan alternatives. The data base should also be used extensively in performing the evaluation of competing alternatives.

(6) Select the Concept

The uncertainty of the evaluation parameters for short-range alternatives should be less than for long-range alternatives and the decision should be more obvious. This is a decision that can be changed or altered as a result of feedback from later phases of the planning process. In short-range planning, the decision not to accept any alternative but to go back for a better examination of the parameters of the question is also in order. As with long-range planning, the choice of an alternative concept is based upon the best combination of acceptability, cost and effectiveness and is not dominated by one of these factors alone.

(7) Implementing the Decision

Implementation of short-range plans follows the same outline discussed in previous paragraphs for long-range plans. These procedures involve a series of decisions and also the management structure required to implement and control those decisions.

Short-range plans are often project oriented and the size of the project can be highly variable. The entire management structure required to implement and control a short-range plan can consist of one person and that person can also be the planner. At the other end of the spectrum, some short-range plans involve high costs and many appropriate complex activities for which the management structure has multiple tiers of part-time and full-time persons. The magnitude of the implementation phase should be compatible with the needs of each project and each program.

(8) Evaluate the Results

An objective measure of the success of the implementation of a short-range project should be required. The parameters of the evaluation and the process of evaluation are usually more visible and the data more apparent than in long-range programs. The same type of evaluation should be planned for as was discussed under long-range plans. Only the scope should change.

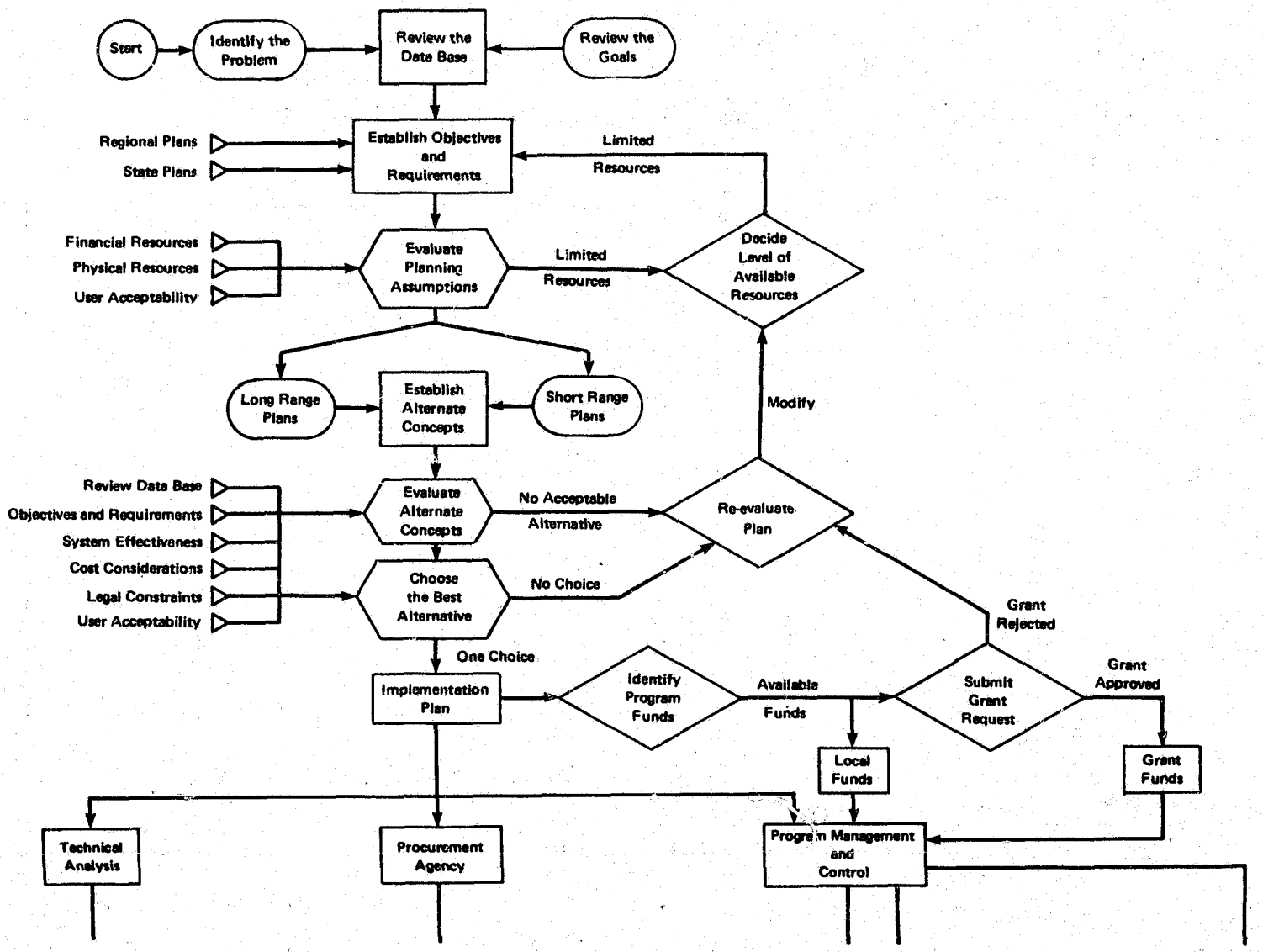
The planning process is a logical process that should be flexible enough to accommodate any size project under a long-range plan or a short-range plan. If the project is large enough to require many skills in its planning and implementation, the plan may be written down in detail and published formally as a comprehensive plan with numerous short-range plans supporting it. If the project is small enough to require only the part-time skills of one person, the written plan can be as small as a schedule and a check list for that person's own use. Either way the planning is formalized, in that, it follows a series of conceptual phases that lead logically to a solution of the planning need.

Planning logic will lead to points within the plan outline where decisions are made regarding how the plan is to proceed. The decision to terminate the plan is a valid decision at any of these points. The location of these decision points is not evident from block diagrams such as Figure 1. A flow diagram such as the sample shown in Figure 2 will define these decision points. Such a diagram would be needed only for very large programs where the timeliness of the decision has a major financial impact.

It is appropriate for the planner to document his plan. The descriptive document should not be more detailed than is necessary for other participants to know what is

being done, why it is being done, who is doing it, and what resources are available. A suggested topical outline for a plan description is shown in Appendix B.

A common denominator for the long-range plan and the short-range plan is an adequate data base. The discussions of telecommunications planning elements in the following chapters will assume the support of a well constructed data base as is discussed in Chapter III.


Start
Identify the Problem
Review the Data Base
Review the Goals
Regional Plans
State Plans
Establish Objectives and Requirements
Limited Resources
Financial Resources
Physical Resources
User Acceptability
Evaluate Planning Assumptions
Limited Resources
Decide Level of Available Resources
Long Range Plans
Establish Alternate Concepts
Short Range Plans
Modify
Review Data Base
Objectives and Requirements
System Effectiveness
Cost Considerations
Legal Constraints
User Acceptability
Evaluate Alternate Concepts
No Acceptable Alternative
Re-evaluate Plan
Choose the Best Alternative
No Choice
Grant Rejected
One Choice
Implementation Plan
Identify Program Funds
Available Funds
Submit Grant Request
Grant Approved
Local Funds
Grant Funds
Technical Analysis
Procurement Agency
Program Management and Control

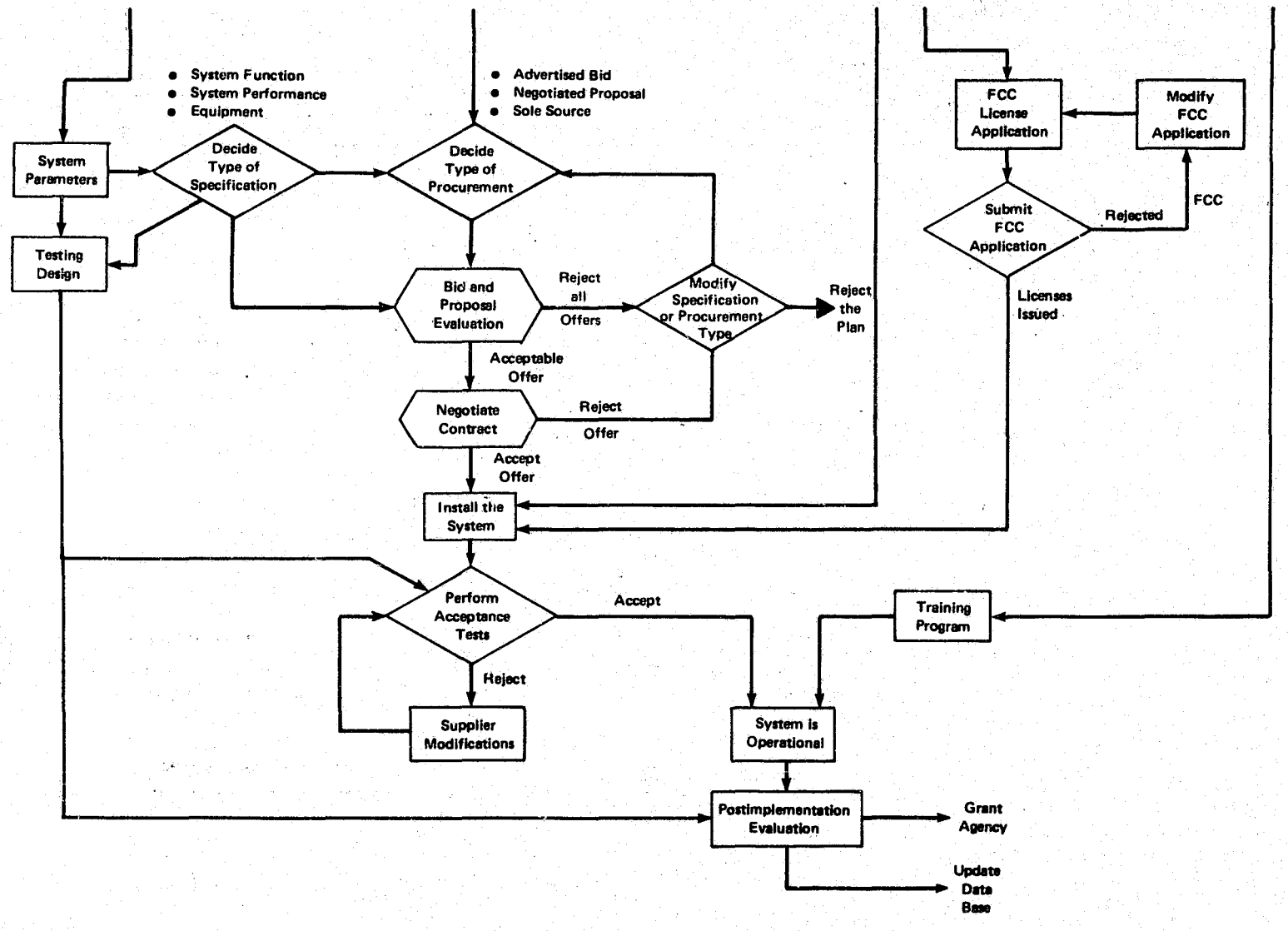


FIGURE 2
Sample Planning Decision Chart

CHECKLIST

II. THE PLANNING PROCESS

1. Has the type of plan been decided? ☐

   Long-range plan ____
   Short-range plan ____

2. Have all planning phases been completed? ☐

   Needs and problems are confirmed ____

   Objectives and requirements are established ____

   Planning assumptions are confirmed ____

   Alternative concepts are identified and evaluated ____

   Best alternative concept has been chosen ____

3. Have implementation plans been completed? ☐

   Project management needs defined ____

   Engineering management needs defined ____

   Procurement agency procedures defined ____

   Legal considerations and needs defined ____

4. Have post-implementation evaluation plans been completed? ☐

   Evaluation parameters defined ____

   Data base update plan completed ____

III. ESTABLISHING A DATA BASE

III. ESTABLISHING A DATA BASE

In telecommunications system planning, an initial step is that of establishing an effective data base, a collection of basic and factual information organized for rapid search and retrieval. The data base provides a measure of the status of the existing telecommunications system, its resources, and its management. From this data base evolves the identification of specific system improvements needed to meet goals and objectives resulting from defined system inadequacies.

All agencies that are responsible for management decisions regarding the planning of telecommunications systems, implementation of the systems, evaluation of the systems, or management of the systems will need and use a data base. The size of the data base and the sophistication of its data retrieval methods will depend on the scope of the telecommunications management system responsibilities and the equipment available for data system management. See Table 2. A State Planning Agency will have a greater need for data management sophistication than will a county planning agency. The telecommunications data base for a large metropolitan police force will be larger and retrieval of the data will be more sophisticated than will the data base of a township police department. However, to permit comparisons of data elements at these several levels, it is desirable that a common terminology exist between data systems. For example, it would not be possible to directly compare crime rates expressed in terms of crimes per capita in one region with crime rates expressed in terms of crimes per thousand dollars of industrial valuation in another.

The data base files are used to:

- Identify existing system inadequacies
- Identify system objectives
- Establish implementation priorities through the quantification of needs
- Document the current system parameters for use in post-project evaluation
- Identify existing resources to be used for system improvement.

The data base files must be sensitive to change. Regular updating should be planned, and the files should have a regular program of audit and validation to ensure data accuracy and currency of the stored data in each file.

The periodic updating and evaluation of the data base will serve as a method for continuous monitoring of the telecommunications system to identify system degradations that may have reduced the overall effectiveness of the system. A current data base will also serve as the basis for any subsequent additions or modifications to the system.

Table 2
Data Base System by Agency Size

Agency	Data System
Local Agency with Local Responsibilities	Data base is compiled manually in tabular form from the survey information or from the search of agency storage files Storage should be by subject subdivisions, and indexed for manual retrieval Retention of the data should be in file cabinets or, if available, in mechanical files Retrieval of the file document is by manual search
Larger Agency with Local Responsibility	Data base is compiled manually in tabular form from the survey information Storage should be by subject subdivisions, and indexed for manual retrieval Retention can be by microfilm, microfiche, punch cards or magnetic tape memory Retrieval is manual from the film or tape library Readout is by optical reader/printer, card reader/printer, or by computer system peripheral devices
Regional or State* Agency with Wide Area Responsibility	Data are coded and entered into a computerized system Storage is in the coded computer files Retention is on magnetic tape or disc files Retrieval is computerized according to programming instructions Readout is by automatic printer or CRT peripheral device with printer capability

*Data management specialists in computerized information systems design should develop these systems if maximum use of computer system hardware and software is to be realized.

1. ELEMENTS OF A DATA BASE

The data base files can be divided into three general classifications: inventory of resources, management data files, and technical data files. The following paragraphs discuss the content of these files and suggest methods of developing a data base.

(1) Inventory Files

Inventory files are lists of the current physical assets and resources of the law enforcement telecommunications system in the city, region, or state. The files are established and updated by periodic surveys of the law enforcement agency or agencies within the planning jurisdiction. Each law enforcement agency should maintain its own inventory files and submit appropriate data from them to the jurisdictional planning agency at the regional or state level. Some suggested subdivisions of these files are listed in Table 3. For example, the table shows that the make, model and age of all hardware units in the computer system, control consoles, base stations, mobile stations, portable stations, microwave control links, data terminals, recording systems and emergency power units should be filed in the data base.

(2) Management Files

Management files contain organizational, operational and subsystem data that will assist in the management of the law enforcement telecommunications resources. These files are established and updated by periodic surveys of the law enforcement agencies within the planning region and by periodically obtaining confirming data from local, state, and national criminal justice agencies. The management files are an important input for obtaining a clear understanding of the functional and operational requirements of each law enforcement unit and for identifying and evaluating alternative organizational concepts for management of the planned telecommunications system. Suggested data elements are displayed in Table 4 where, for example, it is seen that labor and overhead cost per shift would be recorded for the computer center, the dispatch center, the planning unit and the administration unit as these costs apply to the telecommunications system.

(3) Technical Files

Technical and engineering data files are established and updated as resource material needed to support telecommunications system design and improvements. Some of the suggested basic files that provide the needed resource data are outlined

Table 3
Inventory File

Data Required	Data Source								
	Computer System	Control Consoles	Base Stations	Mobile Stations	Portable Stations	Microwave Control Links	Data Terminals	Recording Systems	Emergency Power Units
Make, Model, and Age–All Hardware Units	X	X	X	X	X	X	X	X	X
Location of All Base and Remote Units	X	X	X			X	X	X	X
Number of Units	X	X	X	X	X	X	X	X	X
Number of Channels per Unit		X	X	X	X	X	X	X	
Frequency of Each Channel		X	X	X	X	X			
Assignment of Each Channel		X	X	X	X	X	X	X	
Mode of Operation of Each Channel	X	X	X	X	X	X	X	X	
Transmitter Power Output			X	X	X	X			
Receiver Sensitivity, Noise Blanking, Output			X	X	X	X			
Selective Signaling Tone/Digital Devices		X	X	X	X	X			
Antenna Towers, Transmission Lines, and Filters			X			X			
Antenna Location, Height, Gain, Pattern, etc.			X			X			
Number Remote Control Links–Wireline/Radio	X		X			X			X
Number and Type of Mobile or Fixed Data Terminals	X			X					
Number of Repeaters–Fixed and Mobile			X	X	X	X			
Number of Portables and Mobiles				X	X				
Number of Auxiliary Booster Amplifiers			X	X	X				
Number and Type of Battery Chargers			X	X	X				
Number and Type of Logging Recorders		X	X			X	X	X	
Number and Type of Instant Playback Recorders		X						X	
Number and Type of Closed Circuit TV Units		X	X					X	
Number and Type of Pagers and Public Address Systems		X	X	X	X				
Number and Type of Facsimile Systems		X	X	X	X		X	X	
Number and Type of Telemetry Systems			X	X	X	X	X		
Number and Type of Electronic Sirens and Warning Devices			X	X	X				
Continuous and Intermittent Power Rating			X	X	X	X			X
Maximum Allowable Time at Full Power			X	X	X	X			X
Type and Characteristics of Activation Systems						X		X	X
Voltage, Current, Frequency and Phase Ratings	X	X	X						X
Fuel Type and Storage Requirements									X
Identity of Data System Accessed by Each Unit	X	X					X		
Number and Type of Data Display Units	X	X							
Number and Type of Situation Display Units		X							
Security System Type and Characteristics	X	X	X	X		X	X	X	X
Number and Type of Leased Units	X	X	X	X	X	X	X	X	X

Table 4
Management Files

Data Required	Data Source				
	Computer Center	Dispatch Center	Telephone System	Planning Unit	Administrative Unit
Labor and Overhead Cost per Shift	X	X		X	X
Training Costs	X	X		X	X
Maintenance Costs per System and Unit	X	X			
Lease and Rental Costs	X	X	X		X
Hardware Purchased Prices	X	X	X	X	X
Number of Agencies Dispatched per Shift		X			
Number of Dispatch Positions per Shift		X			
Number of Complaint Positions per Shift		X	X		
Number of Personnel by Classification per Shift	X	X	X	X	X
Annual On-Air Time and Down Time per System	X	X			
Communication Traffic Rates—All Circuits		X	X		
Information System Traffic Rates	X	X			
Intrusion and Fire Alarm Rates		X			
Crossband System Activation Rates		X			
Phone Patch System Activation Rates		X	X		
FCC License Renewal File				X	X
Mutual Aid Communication Plan and Agreements		X			X
Disaster Communication Plan and Agreements		X			X
Catalog of Computer System Output Reports	X				X
Charts of Mutual Aid and Statewide Frequency Channels		X		X	
Copies of Lease, Rent and Use Agreements					X
Number of Emergency Telephone Lines		X	X		
Number of Administrative Telephone Lines		X	X		X
Number and Type of Special Wirelines (WATS, etc.)	X	X	X		
Computer Aided Dispatching Facility	X	X			
Vehicle Locater and Display Facility	X	X			
Phone Patch Capability	X	X	X		
Computerized Research Allocation Program	X	X		X	X

in Table 5. Required radio propagation data are often available from the firms that have provided engineering services in support of previous equipment installations. The most current data should be acquired by obtaining the engineering data generated in support of new license applications or applications to modify existing licenses. Contracts for the design or implementation of public safety telecommunications systems within the planning area should contain a standard contract clause that requires that all engineering data generated under the contract be added to the data base technical files.

2. METHODS FOR DEVELOPING THE DATA BASE

The specific data needed must come from the user agencies themselves. Deliberate plans must be formulated and carried out for the accumulation of this data and for the development of the data base. Leadership in defining the elements of the data base and ensuring the comprehensiveness of the files should be provided by the planning agency. The user agencies will be encouraged to participate in the development of the data base and its files if they have a clear understanding of their need for the data base, the use of the data in the files, and the need for maintaining accurate and current data. These data sources are critical to the success of the data base development and should receive the maximum attention. Sources of supporting information include the standard statistical services that traditionally supply economic and demographic data to taxing authorities and business planners within the planning region.

A formal methodology is needed if a truly comprehensive telecommunications system data base is to be obtained and kept current. The written procedure should include the following eight steps:

- Identify the user community
- Identify the system manager
- Prepare the data survey package
- Conduct orientation meetings
- Collect the data
- Compile the data base
- Analyze the data base
- Update the data base.

The following paragraphs discuss each of these steps.

Identify the User Community – To determine the extent of the data base contents, its scope of application must be determined. If the telecommunications system is intended to serve law enforcement agencies only, the contents

Table 5
Technical Files

Data Required	Suggested Data Source
Vendors' Catalogs of Available Hardware	Vendors' Representatives
Specifications for Present System Hardware Items	Procurement Documents from Purchase Contract
Specifications for Present System Performance Parameters	Procurement Documents and Test Results
Installation Data for Present Hardware Items	Hardware Installation Manuals and Instructions
Computer System Programs and Users' Manuals	Computer Center and Computer Vendor
Information System Users' Manuals	Information System Vendor or Owner
File of Standard Procurement Specifications and Procedures	Regional or State Law Enforcement Planning Agency
Spectrum Management Data	Federal Communications Commission (FCC)
Records of Radio Channel Interference and Noise	Logs of the Dispatch Center and Communication Center
Propagation Test Results—Radio Coverage Maps	System Contractor Engineering Unit and System Test Reports
Propagation Analysis Data for In-Service Channels	System Contractor Engineering Data and System Test Reports
Logs of Traffic Loads by Type for Wirelines and Radio	Logs of the Dispatch Center and Communications Center
Queueing Analysis for Wireline and Radio Channels	System Engineering and Telephone Company Engineering
Topographic Maps of Radio Service Area	United States Geological Survey—U.S. Department of the Interior
Statistical Projections of Area Population Growth	U.S. Census Data—U.S. Census Bureau
Statistical Projections of Area Demographic Trends	Local Chamber of Commerce Statistical Service
Statistical Projections of Area Crime Rates	In-House Projection from U.S. Department of Justice UCR Data
Statistical Projections of Wireline and Radio Traffic Growth	In-House Projection from Historical Growth Data

of the data base will be very different than if the telecommunications system is to serve all public safety agencies, including fire and health services. All the agencies involved and the range of their individual responsibilities should be identified as well as those agencies with which the system will interface.

Identify the System Manager – Effective leadership of the data task will require the prompt identification of the data base manager. The authority and responsibility of this manager must be made clear to the user community. Consideration should be given to the appointment of a person who can identify closely with the operating personnel of the previously identified user agencies.

Prepare the Data Survey Package – The data survey package consists of the data questionnaire and any instruction material needed to complete the questionnaire. The data survey package should be carefully constructed to produce the maximum amount of information with the minimum amount of work by the user organizations and the data reduction staff. Several iterations will be required before an ultimate product that will satisfy the data input needs is developed. A plan for compiling, storing, and retrieving the information should be developed concurrent with the design of the data survey package. The data survey package should require a minimum of effort to code and transfer the data into the data base files, regardless of whether computer coding or manual coding is used. The data survey package will be carefully planned for rapidly compiling the information in a form that permits accurate retrieval. Questions should be designed to fulfill the special needs of the inventory files, management files, and technical files as outlined earlier in this chapter (Ref. 3).

Conduct Orientation Meetings – Before final distribution of the data survey package, orientation meetings with the user agencies should be conducted to ensure their support. Their participation in the development of the data survey package should be encouraged and the resulting changes made before the package is finally configured.

Collect the Data – Some of the traditional methods of conducting the data survey are compared in Table 6. The type of survey needed for telecommunications system purposes is usually a 100 percent survey and the rules and techniques for sampling do not normally apply. The personal interview method is much preferred in telecommunications research over a mailing survey. However, if the cost of 100 percent personal interviews of participating agencies is prohibitive, the combination method of mailing the data survey package and following up with a telephone interview is an alternative way of conducting the survey. It can also be determined from the telephone interview

Table 6
Survey Methods

Method	Advantages	Disadvantages
Personal Interviews *	Yields a higher number of returns from a 100 percent sample. The information is likely to be more correct Supplementary information can be recorded to clarify the responses. The informant will become oriented to the topic under investigation. The language of the questionnaire can be clarified by the interviewer. The informant can contribute additional and relevant topics.	Costs of labor and transportation are excessive for large samples. Poorly trained interviewers can distort or bias the returns. The organization of interviewers, supervisors and planners is more complex than with other survey methods. The interview and transportation takes more time than with other methods. The block of interview time must be convenient for the informant.
Mail Surveys **	Wider distribution in less time. No interviewer bias. Centralized Control from one office with built-in controls. Better likelihood of a thoughtful reply particularly if historic data is needed for an adequate response. Lower cost of labor and transportation. Questions may be answered at the convenience of the informant.	The problem of the nonrespondent affects survey accuracy. Follow-up mailings may be required for an acceptable response. Questionnaire may be too long or too difficult to insure a high level of confidence in the data. Misinterpretations may go undetected and unrealized. No control over the quality of the informant. Questions must be very carefully standardized and self-explanatory. Checks on the honesty and reliability of the return are difficult to devise. Unsatisfactory or incomplete questionnaires are difficult to correct. Written answers may be misinterpreted.
Telephone Survey ***	The principal advantage is economy and speed. Tends to command greater attention and imperativeness. High degree of control from one centralized location. Refusal rate is usually very low. Replies can be recorded for more convenient transcription.	Detailed data cannot be acquired due to time factors. Visual aids cannot be used to assist the informant. Lack of uniformity between telephone interviewers. Information must be limited to a few facts. The brevity of the interview prevents proper orientation of the informant to the topic under discussion Misinformation is hard to detect and check. The informant may not be the best qualified but only the best available at the time of the call.

* For additional information see:
Charles S. Mayer, "Data Collection Methods: Personal Interviews," Handbook of Marketing Research, ed. Robert Ferber, (New York, McGraw-Hill, 1974), pp. 2-82 to 2-89.

** For additional information see:
Paul L. Erdos, Professional Mail Surveys, (New York, McGraw-Hill, 1974), pp. 22-74.

*** For additional information see:
Stanley L. Payne, "Data Collection Methods: Telephone Surveys," Handbook of Marketing Research, op cit, pp. 2-105 to 2-123.

whether a personal visit by the survey team is appropriate. When the data base is being established by one agency, or a small group of agencies, a formal data survey is clearly inappropriate. For these situations a check list of needed data base files can be constructed from the tables of inventory files, management files and technical files and these data items can be accumulated into one central data file from the numerous agency storage files.

Compile the Data Base – Alternative approaches to the compilation of a data base include the use of manual files, semiautomatic files, or computerized storage and retrieval systems. The choice depends upon the size and scope of the data base and that of the agency assembling the data base. Availability of personnel and funds is also a major consideration. Some basic factors affecting the compilation of the data base for different agencies are shown in Table 2. The format of the data base must accommodate the requirements of: (1) indexing and classification of the data to enable accurate and prompt retrieval; and (2) arrangement of the data to enable analysis and statistical evaluation with minimum mathematical manipulation or physical rearrangement.

Analyze the Data Base – The data base is a fundamental management planning and decisionmaking tool. Its outputs will define the status of the telecommunications system and its capability. As the responsibilities and missions of the law enforcement agency change with time, the ability of the telecommunications system to meet these challenges is constantly evaluated through analysis of the data in the files. Additional resources needed to meet these new demands on the system will become evident. The technical files provide the tools needed to define these added resources and to integrate them into the existing system. A rising system down-time identifies older ineffective equipment to be replaced and rising labor costs may flag the need for training or better organization.

Update the Data Base – Inventory files and management files are updated annually or biannually by a data survey similar to the survey that established the initial file. Demographic and economic files and their statistical projections are updated by regular subscription to the services that traditionally provide this information to taxing authorities, government, and business. The technical files may be updated by requiring that all data generated in the course of making telecommunications system changes be forwarded to the data base, together with all reports on technical studies made in support of system changes or system evaluations. The effective data base manager will conduct an annual audit of the telecommunications resources versus the missions and roles of the constituent law enforcement agencies.

The importance to public safety telecommunications planning of a properly composed and organized data base will be further amplified and become more evident in later chapters.

CHECKLIST

III. ESTABLISHING A DATA BASE

1. Does the data base include all major files? ☐

   Inventory files ____

   Management files ____

   Technical files ____

2. Are the Inventory Files complete (see Table 3)? ☐

3. Are the Management Files complete (see Table 4)? ☐

4. Are the Technical Files complete (see Table 5)? ☐

5. Has a methodology been established for data base management (see Section 2)? ☐

6. Have data collection methods been standardized (see Table 6)? ☐

7. Has the data base been complied for efficient retrieval (see Table 2)? ☐

8. Has a program been established to update and validate the data base (see page 30)? ☐

9. Have all existing data files been examined and all useful data extracted? ☐

IV. SETTING GOALS, OBJECTIVES, AND REQUIREMENTS

IV. SETTING GOALS, OBJECTIVES, AND REQUIREMENTS

The planner, to successfully direct a program from concept through implementation to evaluation, must steer a well defined and deliberate course. A telecommunications program that advances the effectiveness of law enforcement must call on the public treasury and on community support for implementation. Each dollar and each minute of time will be challenged by all other tax-supported services that view these resources as being subtracted from the resources available to them. Support for the law enforcement program will depend in large part on clear and well documented evidence of need. A well formulated and documented progression of program goals, program objectives, and program requirements will enable the planner to define these needs and to increase the likelihood of their fulfillment. Further, the substance and priorities of the program goals, objectives and requirements must satisfy established statutory provisions (Ref. 4).

1. DEFINITIONS

The establishment and achievement of *goals, objectives, and requirements* follow such similar paths that the words are often interchanged. It is generally agreed among authorities that a "goal" is a more general term than "objective," and a "requirement" is usually subordinate to an "objective." Widely accepted definitions of goals and objectives are found in *Report on Police* (Ref. 5). These definitions will be used throughout this discussion.

- *Goal* – A statement of broad direction, general purpose, or intent. A goal is general and timeless and is not concerned with a particular achievement within a specified time period.

- *Objective* – A desired accomplishment that can be measured within a given time frame and under specifiable conditions. The attainment of the objective advances the system toward a corresponding goal.

Additional levels of program definition are needed by the law enforcement planner. An interrelated series of broad technical, financial, legal, and political requirements and tasks must be satisfied before an objective can be attained. The following definitions will be used throughout this discussion.

- *Requirement* – A desired accomplishment that is subordinate to an objective. A requirement is attainable within a specified and immediate time limit, is consistent with the time frame of the objective and is clearly measurable, often in numerical values. The attainment of a requirement is usually based on the performance of one or more tasks.

- *Task* – The smallest increment of self-achievable work that is identifiable, assignable and measurable within an immediate time frame. A task may be time dependent on other tasks in that one task would start only after the start or completion of another task.

The example in Table 7 illustrates the relationships between goals, objectives, and requirements. Achievement of each stated requirement is necessary to accomplish the objective of reduced response time. Accomplishment of this objective contributes to and supports achievement of the goal.

Factors to be considered in establishing goals, objectives, and requirements are discussed in the subsections that follow. Task identities are self evident once requirements are defined and, since they take on an endless variety of definitions, tasks will not be discussed further.

Table 7
Illustration* of Goals, Objectives, and Requirements

Example of a goal:

- Increase criminal apprehension rate

Example of one of several possible objectives that support the above goal:

- Reduce response time to 3 minutes

Example of one of several possible requirements that support the above objective:

- Effective citizen access via telephone with:
  - Probability of busy signal equal to 0.001 or less
  - Probability of 10-second delay in answer of telephone equal to 0.001 or less

*Examples are illustrative only and the indicated parameters are not intended as standard for goals, objectives, or requirements.

2. GOALS

Goals of a tax-supported unit of government, such as a law enforcement agency, must be consistent with its legislatively mandated responsibilities. The telecommunications planner's primary function is that of reviewing the goals and assisting in the development and recommendation of objectives in support of the goals.

3. OBJECTIVES

The planner must establish a set of attainable objectives for each project goal. These objectives define the course of action needed to advance the system toward the goal but are more substantive than the corresponding goal in that they equate to a definite time frame, are clearly attainable within that time frame, and are measurable.

The law enforcement communications system is a supporting function of a greater public safety responsibility. Therefore, a communications system objective may be an operational law enforcement objective such as the example in Table 7, "reduce response time to less than 3 minutes," or it may be a clearly identified communications system objective such as "establish a centralized public safety dispatching center." The telecommunications planner will provide the guidance needed to ensure that each objective is clearly related to a previously established system goal and that attainment of the objective is measurable within an established time frame.

(1) Use of Goals to Identify Objectives

The goal defines the ultimate capability that is desired and a logical first step in identifying objectives is to review and analyze the goals from the viewpoint of the course of action through which such goals may be reached. A listing of the conditions to be met in order to reach a goal will identify a number of potential objectives. A rearrangement in the order of dependency will separate objectives from subordinate requirements.

(2) Use of a Data Base to Identify Objectives

Examination and analysis of the data base will often reveal areas of deficiencies in the existing telecommunications system. These areas may indicate program objectives if properly correlated with program goals. For example, the current data base may reveal that the portable-to-portable communications traffic generated by a newly established regional narcotics squad is causing congestion on the sheriff's dispatch channel, resulting in disruption of both functions. This deficiency may lead to an objective to establish a dedicated regional tactical network, thereby supporting the goal of reducing the flow of narcotics into the region.

Another method for identifying possible objectives from the data base is the comparison with the data bases from similar cities, regions, or states. Significant differences may identify candidate objectives.

(3) Use of Resource Agencies to Develop Objectives

The attainment of effective telecommunications system objectives requires inputs from all elements of the public safety telecommunications community. Resource agencies should be used to provide inputs. Table 8 lists some of these agencies.

(4) Use of Recognized Standards to Identify Objectives

The National Advisory Commission on Criminal Justice Standards and Goals has published a series of Task Force Reports that address the criminal justice environment directly. Of these, the *Report on Police* (Ref. 5) and the *Report on the Criminal Justice System* (Ref. 6) are of immediate interest to the telecommunications system planner in setting program objectives.

Also, under the Law Enforcement Assistance Administration guidelines, each state must develop a Comprehensive Law Enforcement and Criminal Justice Plan that establishes statewide priorities for the improvement and coordination of all aspects of law enforcement and criminal justice. This document, and any of the planned or existing communications system master plan documents within the state or planning regions, should be consulted as an aid in establishing program objectives (Ref. 4).

(5) Review of Objectives

It is important that any proposed objectives be well understood and accepted by the people responsible for project implementation and evaluation. A review of the objectives by all interested parties prior to general publication should be encouraged.

The review process should address, in particular, factors relating to:

- The attainability and feasibility of the objective
- The impact of the objective in reaching the goal
- Priority of the objectives.

Table 8
Resource Agencies for Developing Program Objectives

Resource Agency	Area of Interest
Municipal Police	Day-to-day local law enforcement and public safety requirements
County Sheriff	Interagency law enforcement communications. Criminal justice interface with courts, detention, and corrections
State Police/ Highway Patrol	Wide area intrastate and interstate public safety communications needs
Courts	Communications interface with law enforcement activities in detention and warrant service Interface with criminal justice information systems and the privacy of CJIS information
Community Service Organizations	Community needs as seen by special interest groups
State Planning Agencies	Statewide plans for law enforcement telecommunications systems for public safety and law enforcement
State Telecommunications Directors	Wide area integration of telecommunications services
Equipment Suppliers	Hardware and software state-of-the-art developments
Professional Associations	Technical assistance available from such organizations as APCO, EIA, IACP, and others
Civil Preparedness	Disaster planning and emergency communication coordination
Other Public Safety Organizations	Coordination of public safety communication resources
Federal Agencies (LEAA, HEW, DOT, FCC, etc.)	Federal guidelines and standards

Distribution of the proposed objectives for review should include all resource agencies and user agencies. Documentation describing the objectives, the background data needed for analysis, and the rationale for the objectives should be incorporated in the review package along with a blank review form containing requests for specific comments on each objective.

The extent of the review process will depend on the magnitude, scope, and sophistication of the proposed objective. Programs of limited scope could be reviewed adequately by informal discussions with responsible personnel of the user agency.

4. REQUIREMENTS

The planner must establish a set of attainable and measurable requirements for each project objective. These requirements define the course that must be followed in meeting project objectives. They are the action items that establish the dimensions of the work to be accomplished by the project staff.

The scope of the requirements will include all aspects of system implementation. Each project objective should be fully supported by subordinate requirements covering a full range of definitive technical, financial, legal and administrative considerations. Each requirement must satisfy the test of definition:

- Attainment must be clearly measurable
- Attainment must be reached within a specified time limit.

The example of Table 7 shows a sample of two technical requirements. The numeric measure of system capability that must be met for the system to accomplish its objective is clearly illustrated. Had this project required a multi-jurisdictional centralized dispatch center, one legal requirement could have been the introduction and passage of state legislation establishing an authority to manage the center. Similarly, an administrative requirement could have been the adoption of a resolution by each political entity to participate in the planning and operation of the dispatching center. All of these requirements meet the test of definition and are of major importance in meeting project objectives.

(1) Use of Objectives to Identify Requirements

The procedure for identifying objectives from project goals has resulted in the listing of conditions and parameters to be met in the order of their dependency. The

more specific of these technical, financial, legal and administrative conditions will usually meet the test of definition as a requirement.

(2) Use of the Data Base to Identify Requirements

The files of the data base will provide many of the numerical values for project requirements. The technical files are rich in system performance parameters. The inventory files show the number and type of additional system components needed. The management files provide operational parameters as well as financial data.

(3) Use of Resource Agencies to Develop Requirements

The success of the telecommunication project depends upon its meeting the needs of the user agencies and the agencies with whom it interfaces. Those agencies should be used to provide inputs and the listings of Table 8 can be used again for guidance.

(4) Review of Requirements

The requirements of the project should be well understood and accepted by the people responsible for project implementation. A review of the requirements by these people before general publication is to be encouraged. If the resource agencies were consulted for the development of the project requirements, the review can be relatively informal.

5. TASKS

The individual self-achievable units of work needed to meet a project requirement are identified as project tasks. When the responsibility for meeting each project requirement has been assigned, it is recommended that the initial action of the responsible person be to organize and report on the proposed task structure of the assignment.

6. PUBLICATION AND REVISION

Publication of the goals and objectives is advisable for any tax-supported program in public safety telecommunications. Distribution should include all components of the criminal justice system and elected officials within the jurisdiction. Criminal justice planning groups outside the jurisdiction should be included in the distribution to

encourage an exchange of information. The public should be informed through the news media. Again the appropriate extent of the distribution depends on the magnitude, scope, and expected impact of the objectives.

Program planning should include a regular review of all objectives and their corresponding goals. At the minimum an annual review is suggested.

The preceding paragraphs are not all-inclusive regarding the delineation of project goals, objectives, requirements, and tasks. Each program must be defined in terms of its own unique parameters. What has been presented is a general guide for the planner to use in organizing the project and also a checklist of suggested planning resources. The following Chapters will start the planner on the step-by-step path that will lead to the definition of the telecommunications system and on to its ultimate implementation.

CHECKLIST

IV. SETTING GOALS, OBJECTIVES AND REQUIREMENTS

1. Have public safety goals been identified and reviewed? ☐

2. Have all resources been used to identify objectives? ☐

   Do objectives support the goals? ____

   Has the data base been analyzed? ____

   Have resource agencies been consulted (Table 8)? ____

   Have state and national standards been used? ____

3. Have all resources been used to identify requirements? ☐

   Do requirements support objectives? ____

   Has the data base been used? ____

   Have resource agencies been consulted (Table 8)? ____

4. Have requirements been used to identify tasks? ☐

5. Have the goals, objectives and requirements been documented and distributed for review? ☐

6. Has a program been implemented to review objectives and requirements periodically? ☐

V. SYSTEM CONSIDERATIONS

V. SYSTEM CONSIDERATIONS

Prior to the identification and evaluation of alternatives, there are several system considerations to be investigated which will have a bearing on the selection of alternatives. The considerations relate to existing as well as projected requirements and therefore provide inputs to many of the steps in the planning process, including identification and evaluation of alternatives, selection of the concept, final system design, preparation of specifications, and system evaluation.

Specifically the considerations discussed in this chapter include:

- *Radio System* – Characteristics of message traffic, historical trends in normal and peak hour traffic loading, and projected number of radio channels needed.

- *Telephone System* – Characteristics of administrative and emergency calls, message traffic loads for normal and peak hours, historical traffic loading trends, projection of future normal and peak hour traffic loading, and projected number of complaint writers needed.

- *Data Systems* – The need for law enforcement and criminal justice information.

The analyses as described in this section must necessarily be refined in the final system design.

1. RADIO CHANNEL CONSIDERATIONS

On an individual user basis and on the basis of regional cooperative use, the planner should determine whether the current radio channel capacity is sufficient and whether it will be sufficient in the light of a changing demand for service and the established objectives and requirements. He should confirm that normal functions for operations and coordination are accounted for by present use of the channels and that administrative traffic and point-to-point traffic is assigned to the proper communications channels. Required inputs for this analysis will have been obtained from the user agencies and included in the data base. These inputs will include radio message volume and duration, operational data, organizational data, and coordination requirements.

To project future message traffic, the historical change in radio message traffic volume may be correlated with historical changes in demographic factors and previous changes in law enforcement services and procedures. Consideration must be given to growing requirements for mobile data transmission, video transmission, computerized dispatching procedures, automated vehicle locator systems, security of information, and the ever increasing need for wide-area interagency law enforcement communications. Equating these traffic load projections to radio channel requirements will require technical judgment on the part of the evaluators.

The most thorough approach is that of using classic queueing analysis to establish channel requirements (Ref. 7). Caution must be exercised in applying this theory to ensure that the input parameters – projected message volume and average message duration – are not inflated because of existing poor channel discipline and/or poor dispatcher technique. Specialized technical assistance in applying queueing theory to communication system design should be considered. Queueing theory can also be used to compute the channel occupancy as well as expected waiting times. When the statistical calculations have shown, for example, that channel occupancy exceeds approximately 35 to 40 percent in the peak hour and/or average waiting time exceeds 5 seconds, field measurements may confirm that additional channels can be justified.

Commonly used criteria to establish channel requirements have evolved based on representative field data (Ref. 8). These general principles, for example, have traditionally supported channel loadings of from 20 to 50 vehicles per channel. Caution must be used in applying these traditional criteria because of differences in channel uses, mode of operation of departments, and vehicle utilization. Many municipal departments, for example, efficiently operate with channel loadings in excess of 50 vehicles per channel, while a channel shared by several departments could operate comfortably with no more than 20 to 30 vehicles on the channel. These criteria, therefore, should be used only for rough estimates and not for final design. Also, the number of patrol units actually on patrol in busy hours should be used as opposed to the number of vehicles owned by the user agencies. A conservative numerical guide might be appropriate for use in developing an overall statewide telecommunications plan for law enforcement agencies but subject to revision pending the results of detailed statistical traffic load analysis of each individual telecommunications center.

2. TELEPHONE LINES

The telephone system links the public to the law enforcement agency, interconnects the departments within the agency, provides communication with other agencies, and also provides remote control for the radio system components. The analysis of the telephone communication portion of the system should specifically address:

- Availability of sufficient trunks for incoming emergency calls to the telecommunications center

- Availability of sufficient trunks for incoming administrative calls to the telecommunications center

- Availability of sufficient trunks for outgoing calls from the telecommunications center

- Availability of sufficient number of complaint writers.

Required inputs for this statistical analysis include the volume of calls and call duration for both emergency and administrative calls. The data will have been obtained from the user agencies and included in the data base. Queueing analysis may then be performed with such data for past years, the present, and estimates for future years to project (Refs. 7, 9):

- The probability of a busy signal
- The probable delay in processing the call.

Note that the system probability also includes the probability of a busy signal at the telephone company switching facilities that are beyond the control of the public safety telecommunications system planner. Engineering representatives of the telephone company should be consulted for confirmation of emergency service probability calculations.

Recommended police standards (Ref. 5) suggest that an emergency call be answered in 30 seconds or less, roughly the time for six rings. Again, this is a standard for minimum performance. By comparison, one major metropolitan police agency for example, requires that complaint telephones be answered within 12 seconds (about three rings) or the call will be switched to a backup supervisory complaint position.

Telephone lines used for control only are dedicated lines without public access and are not subject to the requirements of queueing analysis. However, the planner must take into consideration that long DC control lines may be very difficult to configure in the commercial telephone system and control by keying tones may be preferred. Bandwidth characteristics for data or video may require additional system consideration. Discussions with responsible telephone company representatives are recommended early in the system configuration phase.

3. DATA SYSTEM CONSIDERATIONS

The data system links the law enforcement agency to the criminal justice system and to the national law enforcement community. Data terminals at the communications center connect the agency to the state motor vehicle files, the state CJIS files, the national LETS system and the NCIC files.

Traffic loads and operational concepts are available from the data base and from the participating agencies. User manuals for the terminals should provide the planner with sufficient data to configure his system for the volume of traffic projected for his center, the number of terminals required, and the skill levels of the personnel needed.

A supporting network of facsimile facilities is necessary before a facsimile terminal can be justified in the communications center. However, the planner should include this graphic communications system as a possible system component for future growth.

4. SYSTEM INTERFACES

A law enforcement telecommunications system must interface with a number of external systems including those of adjacent jurisdictions, regional systems, state systems and federal systems. In addition, the man-machine interface is one which warrants special consideration. The planner should therefore identify and define on his system diagram each required interface and incorporate these interface requirements as part of the overall system requirements. System interfaces to be considered might include, for example:

- Information Systems – Intra and interstate
- Other Public Safety Services – Fire, rescue and emergency medical service
- Public safety systems of adjacent jurisdictions
- Civil Preparedness
- Regional, state and interstate coordination
- Man-machine interfaces at the dispatch center, the vehicle and the man on patrol.

The requirements for each of these interfaces should be documented at this point in the planning process and should be later considered in greater detail during the design and specification tasks.

Starting with these fundamental system considerations and a clear understanding of system goals, objectives and requirements, the planner is in a position to develop alternative solutions to the system problems. The development, evaluation and selection of alternative concepts is the subject of Chapter VI.

CHECKLIST

V. SYSTEM CONSIDERATIONS

1. Have radio channel traffic loads been analyzed? ☐

   Is channel congestion a factor? ____

   Is a queueing analysis needed? ____

2. Have telephone line traffic loads been analyzed? ☐

   Are there sufficient emergency lines? ____

   Are there sufficient administrative lines? ____

   Is a queueing analysis needed? ____

3. Have the data system needs been analyzed? ☐

   Has the volume of digital traffic been established? ____

   Will facsimile be needed? ____

4. Have the system interfaces been analyzed? ☐

   Have information system interfaces been considered? ____

   Have public safety interfaces been considered? ____

   Has the interface with Civil Defense been considered? ____

   Have regional, state, and interstate coordination been considered? ____

   Have the man-machine interfaces been considered? ____

VI. DEVELOPING, EVALUATING AND SELECTING FROM ALTERNATIVE CONCEPTS

VI. DEVELOPING, EVALUATING AND SELECTING FROM ALTERNATIVE CONCEPTS

Selection of the system concept evolves from an orderly analysis of the system objectives, the alternative methods of meeting those objectives, the constraints that form the logical boundaries within which the methods of solution must be contained, and from the analysis of alternative cost factors. Many of these basic constraints will have been addressed in the setting of goals, objectives, and requirements. It is appropriate to review briefly the following system constraints that must be considered in the selection of the concept.

- *Goals and Objectives* – The concept must relate directly to the attainment of a goal, an objective, or a requirement.

- *Compatibility* – The concept must be fully compatible with other public safety systems with which it interfaces.

- *Technical Feasibility* – The concept must be technically feasible, achievable with readily available system components.

- *Costs* – The concept must be cost effective. It must also comply with budgetary limitations imposed by the local funding or by grant funding.

- *Legality* – The concept must comply with all applicable laws, ordinances, and regulations. In particular, compatibility with the FCC Rules and Regulations is mandatory.

- *Acceptability* – The concept must be acceptable to the user agencies, to the consumer public, to the local government body, and to the personnel who must operate the system.

It is not uncommon for a planner to have a preconceived idea of the system concept he desires. On the other hand, there are occasions when the planner, at the outset, has no identifiable concept that will meet his requirements and objectives. In either case, alternative concepts should be identified and evaluated to ensure that the final system configuration is the most cost-effective approach, one that will satisfy all the requirements and objectives.

This section discusses methods for identifying alternatives and for performing preliminary evaluations that serve to eliminate all but the more promising alternatives. When possible, several alternatives should be selected as the leading candidates and these alternatives should be subjected to a rigorous cost-benefit evaluation. The development of each alternative concept should be carried only to the degree needed to make an accurate analysis of the relative merits of the alternates.

1. IDENTIFYING THE ALTERNATIVE CONCEPTS

The difficulty in identifying alternatives will depend on the nature of the problem and scope of the project. The methodology for identifying the concepts, therefore, may involve one or more of the following approaches:

- Methodical development of all viable combinations of subsystem alternatives
- Investigation of approaches used by others having similar problems or objectives
- Consultation with system users and others to collect all points of view and system ideas
- Search of existing literature and reference material (Ref. 3).

Identification of alternative concepts for less complex projects will involve minimal effort and may, for example, be limited to search of reference material. A local police department may in the final analysis have only two alternatives: to join an existing cooperative dispatching system or to implement a dispatching system of its own. More complex systems having a number of subsystems will require the planner to expend considerable effort to exhaust the possible alternative approaches.

A system can usually be divided into a number of distinct subsystems. Each subsystem can then be examined to identify its alternatives. Figure 3 illustrates this approach by considering some typical subsystems associated with a law enforcement telecommunications system. In this example there are eight communications subsystems, each with a number of possible alternatives. Analysis and preliminary evaluation of the subsystem alternatives will reduce the number of combinations to a manageable number. The alternatives can be further evaluated through a preliminary feasibility analysis as discussed in the sections that follow.

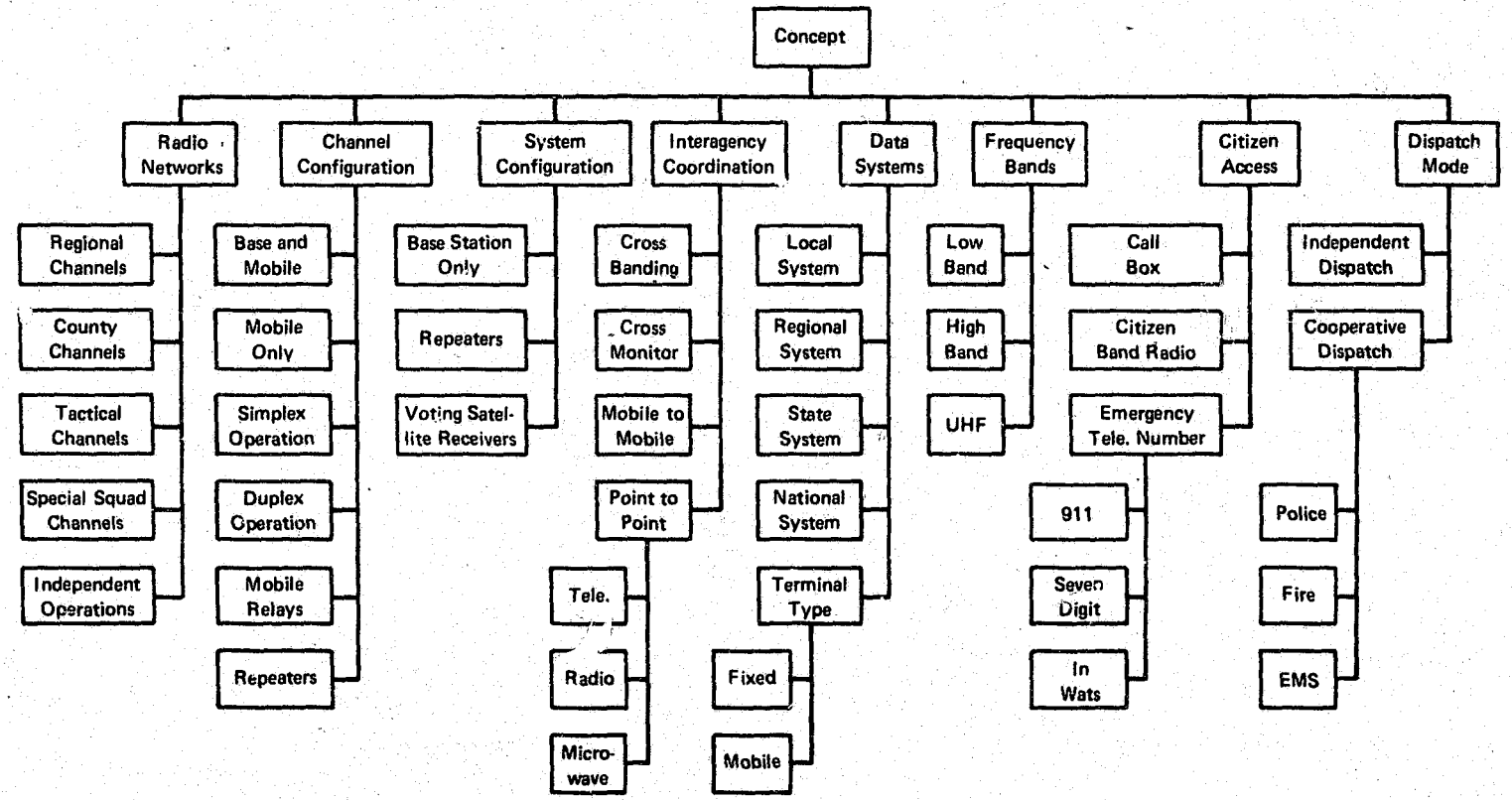


FIGURE 3
Examples of System Alternatives

2. DETERMINING SYSTEM EFFECTIVENESS

Telecommunications system effectiveness can often be quantitatively stipulated in areas such as performance, safety, reliability, maintainability, coverage, availability, and growth capability. Less specific terms, such as benefits, burdens, utility, acceptability, and merit are more subjective but should also be considered when comparing alternative concepts.

(1) Meeting Goals, Objectives and Requirements

The selection of the system concept will include the evaluation of how well each concept achieves a specific program objective, goal, or requirement. These considerations can, for example, include some of the following factors:

- *Radio Channel Adequacy* – The degree to which the concept will affect over-utilized or under-utilized public safety radio channels
- *Telephone Channel Loading* – The degree to which the concept will improve citizen access to the law enforcement agency emergency telephone lines
- *Delay Time* – The effect the concept will have on reducing the time lapse from the receipt of the complaint to the dispatch of a patrol unit
- *Mutual Aid* – The provisions in the concept for coordinating several law enforcement agencies through the telecommunications system
- *Command and Control* – The degree to which the concept establishes improved dispatching and command facilities under routine, emergency, and disaster conditions
- *Radio Coverage* – The thoroughness with which the concept has addressed geographical coverage of the service area
- *System Reliability* – The degree to which the concept will eliminate and replace unreliable and ineffective communications equipment and subsystems
- *Information Systems* – The need for and inclusion of areawide automated law enforcement and criminal justice information retrieval subsystem in the system concept

- *Security* – The degree to which the concept provides protection for confidential handling of criminal justice information and protection of the facility against intrusion by unauthorized persons

- *Personnel Safety* – The provisions in the system concept for warning police and fire personnel responding to a call for assistance of potentially dangerous situations. Also certification that the equipment installation will be safe for operating personnel

- *Maintenance* – The degree to which planning for organized maintenance is included in the system concept

- *Personnel Skills* – The provisions in the concept for operating and maintaining the system with trained personnel of reasonable skill levels.

(2) Determining Operational Compatibility

The understanding has long existed that efficient operations depend upon effective communications. This is true for the operations within an agency as well as for interagency operations.

1. Compatibility With Agency Operations

Operations, and hence telecommunications within an agency, are affected by the size and functional organization of the agency. In small agencies, for example, there may be neither sufficient diversification of function nor sufficient number of personnel to justify more than a single-channel radio system to satisfy its internal requirements.

On the other hand, large departments usually require multiple channels to meet the needs of their specialized units. The planner must ensure that the telecommunications concept satisfies the requirements of the following functions as examples:

- Interagency Communications
- The dispatch function
- Administrative Communications
- The Patrol
- Traffic Division
- Detectives
- Special squads, such as Narcotics and Youth Bureaus
- Prisoner transfer.

The planner must then ensure that the telecommunications alternative under consideration includes the dispatch channels, tactical channels, detectives channels, data channels, and portable communications compatible with the department mode of operation.

In addition, telecommunications coordination capability must be provided for all law enforcement agencies, large or small.

2. Interagency Coordination

The need for coordination with other agencies takes two basic forms: coordination between vehicles of different agencies or coordination between telecommunications centers of different agencies. Depending on the response time required, coordination between vehicles may need a direct link, that is, mobile-to-mobile, or it may need only an indirect link using a dispatcher accessible to both vehicles as a relay point between them. The coordination between telecommunications centers may need voice contact by radio or wire line or it may need only digital contact by teleprinter or computer terminal. More than one method of coordination may be used; for example, mobile-to-mobile coordination may also include mobile-dispatcher-mobile coordination. Likewise, coordination between telecommunications centers may include both voice and digital facilities.

To illustrate these coordination requirements, Table 9 shows a hypothetical coordination matrix for a municipal law enforcement agency. The example is not intended as a recommended plan, but rather is presented to demonstrate an approach for summarizing telecommunications coordination requirements. A given alternative concept can readily be compared with the coordination matrix to evaluate how it meets the interagency coordination requirements.

3. Determining Technical Feasibility

When evaluating the alternative concepts, the first evaluation that a planner should make is to determine the technical feasibility of each concept. A concept that is not technically feasible can be rejected without any further evaluation.

A planner may find, for example, some of the following references a useful supplement to this discussion in checking the technical feasibility of a project.

Table 9
Hypothetical Coordination Matrix for a Municipal Law Enforcement Agency*

Agency	Radio Point-to-Point	Radio Base to-Mobile	Mobile-to-Mobile	Tele-type	Telephone Hot Lines	Tele-phone
Other Municipal Law Enforcement Agencies	X		X	X		X
Sheriff and County Police	X		X	X		X
Fire Departments	X			X		X
Emergency Medical Service		X			X	X
Campus Police	X	X	X			X
Civil Defense	X			X		X
Indian Reservation Police	X		X			X
Security Patrols					X	X
Military Police					X	X
Federal Agencies					X	X
Border Patrols	X					X
Park Police	X	X	X			X
Conservation Agencies						X
Game and Fish						X
Forestry						X
Liquor Control					X	X

*Note that this form and the indications of coordination methods thereon are for illustration purposes only. This illustration is not intended to provide recommendations for telecommunication system configurations.

- *Police Telecommunications Systems* – Prepared by the IIT Research Institute, Associated Public-Safety Communications Officers, Inc. Post Office Box 669 New Smyrna Beach, Florida 32069

- *Technical Terms and Definitions Used with Law Enforcement Communications Equipment* – Prepared by the National Institute of Law Enforcement and Criminal Justice; Available from the Superintendent of Documents, Washington, D. C. 20402 Stock no. 2700-00233

- *Science and Technology Task Force Report* – Prepared by the President's Commission on Law Enforcement and Adminstration of Justice; U.S. Government Printing Office, Washington, D. C. 20402

- *Report on Police-National Advisory Commission on Criminal Justice Standards and Goals;* – U.S. Government Printing Office, Washington, D. C. 20402 Stock no. 2700-00174

Material available from the National Law Enforcement Information System Clearing House*, and the National Technical Information Service might also prove valuable.

Establishing technical feasibility involves analysis and documentation of sufficient evidence to demonstrate that the system approach is achievable from a technical standpoint. This will include consideration of:

- The feasibility of system implementation using readily available components

- Achievability of performance requirements, such as:

  - Radio coverage
  - Telephone access requirements
  - Response times
  - Component and system reliability

- Availability of required frequencies

- Compatibility of available frequencies with other frequencies in use

*National Law Enforcement Information System Clearing House, 950 L'Enfant Plaza, S.W., Washington, D.C. 20531.

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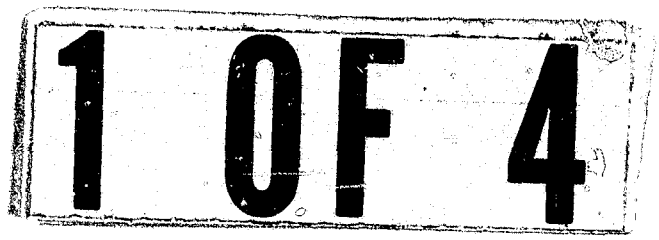

- Availability of necessary real estate and facilities

- Feasibility of required facility modifications and/or equipment modifications.

An analysis may indicate, for example, that the only available new frequencies in VHF high band for use in a subsystem alternative will result in severe inter-modulation with frequencies currently in use. The conclusion will lead to consideration of the use of VHF low band or UHF for the subsystem, or a reassignment of frequencies in VHF high band if these are available. The technical expertise required for these analyses suggests the services of a consultant specializing in this technology if the planner does not have this technical expertise available on his staff.

3. IDENTIFYING SYSTEM COSTS (Ref. 10)

All elements of system costs should be considered in the cost analysis of the competing alternative concepts. Basic cost data should include initial investment outlays as well as operating and replacement costs.

(1) Defining Factors of Cost

The two broad categories of costs are investment costs and operating costs. For telecommunications system planning, consideration should be given to the following factors.

1. Investment Costs

Investment costs are defined as the nonrecurring costs of implementing the program. For telecommunications programs these can include the initial costs for:

- *Hardware* – The initial purchase price of all equipment, tools, test equipment, and furnishings including radios, consoles, test benches, antennas, towers, emergency power generators, furniture, and other hard items are considered hardware costs. The initial cost of spares is also included in this category.

- *Software* – Software costs include operating manuals, maintenance manuals, training manuals, and job classification manuals in addition to computer programs, computer users' manuals, and other computerized system documentation.

- *Real Estate* – Real estate costs include the purchase of land and buildings needed to implement the system. This includes the purchase of rights-of-way or access easements.

- *Services* – Service fees used exclusively on the project include legal fees, engineering fees, transportation costs, riggers expenses, and costs for consultants and architects. These are one-time-only costs.

- *Vehicles* – Vehicle costs include the purchase or one-time lease of vans, trucks, buses, cars, motorcycles, boats, or aircraft used exclusively on the project.

- *Installation* – Installation costs are one-time costs. They include installing the telephone system, primary power system, water connection, and sewer connections.

- *Preparation* – Preparation costs relate to renovation of buildings, preparation of land, and building of driveways and walkways.

- *Labor* – The staff labor hours are considered investment costs when expended in the writing of grant requests and other project efforts. These are one-time costs.

- *Training* – The training of start-up personnel requires initial investment. Special training could be required for computer operators, programmers, terminal operators, and for the technical personnel, including maintenance technicians.

2. Operating Costs

Operating costs are the recurring costs that are periodically billed against the facility after it has been placed in operation. For telecommunications projects these include the following:

- *Personnel* – Personnel costs include labor and overhead for operating, maintenance, clerical, supervisory, janitorial, and other supporting staff.

- *Maintenance* – When the equipment is maintained under contract, the cost of the maintenance contract is an operating cost. Also included in operating costs are the cost of maintenance of buildings and grounds, and the cost of maintenance parts and expendable maintenance materials.

- *Utilities* – The cost of water, heat, light, power, air-conditioning, telephone service, sewer usage, and similar services are operating costs.

- *Leases* – Lease costs include leases for telephone lines, equipment, real estate, and vehicles.

- *Supplies* – All expendable operating supplies, such as stationary, ink, pencils, pads, forms, printing, postage, and duplicating supplies, are included as operating costs.

- *Training* – Training costs include the recurring cost of updating operating personnel and training replacement personnel.

- *Financial* – The cost of debt service, interest on short-term borrowing, insurance, and other surety instruments are financial costs. Certain one-time-only costs such as construction bond premiums can be considered investment costs.

- *Equipment Replacement Costs* – Equipment replacement costs are incurred for each system when the equipment becomes physically deteriorated or obsolete. Where the useful life of alternative system concepts varies, equipment replacement costs also may differ from system to system. It is likewise important to identify the year that these costs will be incurred when performing comparative present value analysis as described in Section 5 of this chapter.

(2) Identifying Cost Savings

Cost savings may be realized from the operation of a new telecommunications system that replaces an existing system. There are two situations where this may occur:

- Replacement of an obsolete system resulting in operating savings through decreased maintenance and repair expenses

- Integration of system elements for systems that currently operate individually.

To estimate potential cost savings from replacing an existing system requires that costs for the existing system(s) be projected to each future year and that the savings from this level be estimated for each alternative systems concept. These cost savings are then analyzed according to the present value methods discussed in Section 5 of this chapter. The particular cost savings that may be realized includes both investment and operating cost savings as discussed in the following paragraphs.

1. Investment Cost Savings

In assigning values to these system cost implications, the planner must consider offsetting both operating costs and investment costs. Some considerations involving investment cost recovery can include:

- *Real Estate* – Funds recovered from the sale of underused buildings and land

- *Hardware* – Funds recovered from the sale or transfer of equipment no longer required by the consolidated facility.

2. Operating Cost Savings

The avoidance of operating costs can include:

- *Personnel* – Assignment of personnel made excess by the system to other duties more in keeping with their training as law enforcement officers

- *Maintenance* – Retirement or sale of equipment, buildings, and land that previously required maintenance funds

- *Utilities* – Termination of utilities in facilities no longer required

- *Leases* – Cancellation of leases on equipment and services no longer required

- *Operating Supplies* – Elimination of supplies in dispatching facilities not being used (the number of printed forms are reduced to one set of consolidated forms)

- *Training* – Reduction of training costs because of smaller number of personnel required

- *Financial* – Closing of unrequired facilities and cancellation of insurance, bonds, licenses, etc.

(3) Estimating System Costs

Once the categories of system costs are identified, system costs should be estimated for each system concept as well as for continued operation of current systems. The initial and recurring costs for each year are estimated for each system concept over a representative period of system operation, say 5 to 10 years. Competing concepts with short-life expectancy should be charged with systems replacement costs to equate them with longer-life systems.

Historical cost data will be needed to make a competent analysis. Annual maintenance costs for each type of equipment planned for the different concepts must be established from historical records. An excellent treatment of this together with some applicable maintenance cost rates is the subject of an article in the *APCO Bulletin* (Ref. 11). The costs for heat, light, air-conditioning, and utility services are significant in many parts of the country and these cost averages are available from prior-year budgets. Typically, operating costs for each system are stated as an annual average using wage rates and material prices that exist at the time the analysis is performed. Table 10 illustrates average annual operating costs for a sample police radio system. For more refined analyses it may be desirable to include year-to-year increases in maintenance and repair costs as a system becomes obsolete and to include the annual escalation of costs for labor, supplies, and services as indicated by previous-year budgets. Table 10 makes no provisions for the amortization of the initial capital expense. In the municipal budget chart of accounts, there is usually no provision for amortization of capital expense, so this has not been included in the illustration.

The year-by-year dollar outlays projected for each system concept over the evaluation period may not adequately present differences in the costs of ownership among competing concepts because of the following:

Table 10
Sample Police Radio System Annual Cost

Item	Buildings	Base Stations	Towers	Mobile Stations	Portable Stations	Dispatch Center	Maintenance Shop	Telephone System
Maintenance*	$ 320	$ 1,272	$ 127	$ 4,420	$ 1,116	$ 1,806	$ 98	$ -
Lease Costs	-	-	-	-	-	1,440	-	9,000
Labor	-	6,250	-	-	-	112,580	6,250	-
Utilities	1,580	375	120	-	-	NA	275	-
Training	-	-	-	-	-	2,610	277	-
Supplies	180	35	32	-	-	1,200	180	-
Contract Service	1,200	240	60	-	-	1,200	-	-
Total	$3,280	$8,172	$ 339	$ 4,420	$ 1,116	$120,836	$7,080	$9,000
							Grand Total	$154,243

System Description

One building for dispatch center, two mountaintop transmitter shelters
Two base stations with antennas, duplexers, and filters
Two antenna towers - 150 feet each
One 2-console dispatch center with supervisor
One maintenance shop with tools and test equipment
Forty mobile transceivers with selective call and 8 channels
Twenty-five portable dual-channel transceivers with charger and spare battery each
One 15-line telephone system at dispatch center

* Maintenance costs for electronic equipment are average percentages of the original equipment costs as determined from several years of maintenance records on similar equipment owned by the same police agency. Maintenance costs on buildings and towers are estimated from the municipal building records for similar structures owned by the city.

- System components may have a useful life or salvage value remaining at the end of the evaluation

- The value of current dollar outlays is not directly comparable to future dollar outlays due to differences in the time value of money. That is, since today's dollars can be invested to obtain a return, they are "worth" more than future dollars and should be so weighted.

The following section addresses each of these important issues.

4. EVALUATING COSTS AND BENEFITS

Quantitative methods for evaluating costs and benefits provide a means of organizing a complex mass of information for evaluating alternative system concepts. In many cases they can provide measures in simple comparable terms, thereby removing much guesswork from decisionmaking. The danger in these methods is that their proponents may focus upon technique refinements rather than basic analysis assumptions and the many important judgments needed to implement them.

The techniques presented in this section lead to two general results:

- Comparison of two projects to show which entails the lowest cost of ownership over the life of the system.

- An index for each concept that permits ranking of a number of concepts.

When only costs or cost savings are quantified, these techniques present an adequate comparison only when equivalent benefits or effectiveness exist. When unequal effectiveness exists, the alternative with the lowest costs of ownership will not necessarily be preferred. In this situation, the analysis techniques discussed in this section will provide a more refined basis for assessing lifetime cost differences among alternative systems concepts.

(1) Basic Concepts of Economic Analysis

The concepts of economic decisionmaking are relatively simple. Some of these concepts are briefly discussed.

1. Least Cost of Time-Distributed Costs or Cost Savings

The result of a decision to implement a system concept is a series of cash outlays, possible cost savings and benefits or costs of the system concept. A sequence of outlays or cost savings, discounted to the present time, is the measure of the cost savings of an investment. Where there are not significant differences in benefits, the least-cost system determined by this method is desirable, since the resources that would unnecessarily be utilized are released for other purposes.

2. Sunk Costs

A second important concept is that past costs of land, buildings, and equipment are by themselves irrelevant to current decisions since they do not affect future cash expenditures. These costs are often referred to as "Sunk Costs."

3. Economic Life

A third concept is that of the economic life of each system concept. This refers to the period of time that the system is assumed to provide beneficial service. The economic life commences with system operation and terminates when the system no longer provides useful service and is abandoned or scrapped.

The economic life for a system cannot be predicted with certainty. It is limited by the following factors:

- Physical life of the materials
- Design life of the system
- Technological life of the system
- Changes in system demands and level of service desired.

Due to the above uncertainties, a system life of no greater than 10 years should be assumed. For individual system components a conservative estimate of design life should be assumed for estimating replacement costs.

4. Residual Value

Residual value refers to the remaining salvage value of a system at the end of its economic life. Typically the salvage value of *equipment* is ignored at the end of its economic life. However, the value of the remaining useful life of buildings, antennas, base stations, and other structures, and the market value of land should be included in order to obtain a meaningful estimate of costs for each system concept.

5. Time Value/Present Value of Money

The fact that a dollar today is worth more than a dollar offered at some future time is referred to as the time value of money. Because of these differences, future costs must be reduced to make them comparable to today's dollars. Present value is a technique for converting cash flows occurring over time to equivalent amounts at a common point in time, in order to make valid comparisons. To analyze a set of alternatives in terms of a present value analysis of costs, the information for each of the alternatives must include the same set of variables and the same date of initial system operation. The decision between competing systems frequently involves a choice between one alternative with high initial costs and low Operating and Maintenance (O&M) costs relative to a second alternative with lower initial costs but higher O&M costs. To facilitate a valid comparison, the costs for each alternative must be expressed in dollars of the same year. To do this, the costs of future years must be translated into their present day value. This is accomplished by applying an interest (discount) factor to the costs for each year beyond the initial year. This calculation yields the present value of the future costs, given an appropriate interest (discount) rate. In other words, the present value is the amount which, if placed in an investment with a yield equal to the discount rate at the beginning of the initial year, would produce the funds (including return of the original amount invested) that are needed to cover the project costs. Mathematically, the present value (PV) of X dollars spent or received at the end of n years is

$$PV = X \left[\frac{1}{(1+i)^n} \right]$$

where i is the discount rate. The expression contained within the brackets is sometimes called a "discount factor."*

*Simplified table of present value or "discount factors," will be found in Appendix A – Hypothetical Plan. For more complete tables see Refs. 10 and 12.

To obtain the present value of the costs for a system concept involves the following steps: (Ref. 10).

- Multiply the costs (benefits) of each system element by the appropriate discount factor for the years to obtain the present value of those costs for each system element.

- Sum the above figures for all system elements to obtain a total present value figure for the project or system.

Comparison of present value cost figures for two or more concepts requires that the costs cover the same time period for each alternative.

6. Discount Rate – Cost of Capital

The discount rate is the interest rate used to discount or apply the time value of money to future costs so as to state those costs in terms of their present value. For private enterprises, current and expected future interest rates are appropriate for use as a discount rate for computing present values. This is the rate that the firm must pay for borrowed funds.

The average cost of borrowing can be utilized as the cost of capital for state and local governmental units. The discount rate for Federal level decisions is specified by the Office of Management and Budget (Ref. 13). At present, a discount rate of 10 percent is specified and detailed information covering the applicability of this rate and appropriate analysis procedures can be obtained from OMB.

7. Uncertainty

Uncertainty is the absence of a basis for accurately predicting the occurrence of an event. Uncertainties may result in the inaccurate measure of costs of an alternative due to changes in relative prices, technological effects, or economic life and unforeseeable developments. A recommended procedure is to test the ranking of a project against a change in analysis assumptions, for example, differing equipment replacement rate, wage levels or other cost changes. Where the rank of the least costly system concept is not sensitive to a change in these assumptions, the decisionmaker can have increased confidence in a decision based on relative costs.

Applying these techniques of economic analysis provides only one of the measures of system effectiveness needed for decisionmaking. The rational selection of the system concept includes the trade-off between costs and the attainment of the program objectives and requirements. The most effective system is not necessarily the least costly system.

8. Relating Costs and Benefits

When the benefits associated with each competing alternative are identical, cost-benefit analysis reduces to that of applying the techniques of economic analysis described above and selecting the system concept based upon cost considerations alone. It is usually the case, however, that competing alternatives will usually have different benefits or will have varying degrees of success in meeting an objective. Evaluation of benefits usually is subjective and will require judgment on the part of the planner.

Quantification of the subjective evaluations of benefits can be accomplished by applying weighting factors to each benefit. Two weighting factors can be applied to each benefit. The first factor, W, is a dimensionless number indicating the importance or priority that the benefit has in relation to other benefits. The second factor, I, is an index number indicating the degree to which the alternative has achieved the benefit in relation to competing alternatives. The summation of the product of the two weighting factors for all benefits provides an overall indication of the merit of the alternative, that is:

$$W_1I_1 + W_2I_2 + W_3I_3 + \cdots W_nI_n = \Sigma\ W_nI_n$$

where n is the number of benefits.

It is usually more informative, however, to prepare a matrix of alternatives versus benefits showing the weighting factors for each benefit, the costs for each alternative and, if possible, the costs associated with each benefit. This matrix will assist the planner both in selecting the system concept and in presenting the analysis to others for their consideration.

It is important to recognize that the cost-benefit analysis is only one of several factors in evaluating the system alternatives. Other factors such as compatibility, legality, technical feasibility and acceptability must also be considered as described in other sections of this chapter.

5. DETERMINING COMPLIANCE WITH LAWS AND REGULATIONS

The second evaluation of the alternative concepts that a planner should perform is to determine whether each concept under consideration is in compliance with laws and regulations. If a concept is highly innovative and if there is an obvious and compelling need for the project, it may be possible to obtain an exception to the laws and regulations in order to implement a concept. Otherwise, a concept that is not in compliance with laws and regulations should receive no further consideration.

The following paragraphs contain discussions of laws and regulations and are a valuable source of information and assistance which the planner should take into consideration when conducting this evaluation.

(1) The Communications Act of 1934, as Amended

The provisions of this Act apply to all interstate and foreign communications by wire and radio and all interstate and foreign radio transmission which originates and/or is received within the United States. They likewise apply to all persons engaged within the United States in such communication or radio transmission, and to the licensing and regulating of all radio stations.

(2) Federal Communications Commission Rules and Regulations

This set of documents establishes the organization and policies by which all communications involving radio and wire transmissions originating within the United States and/or received within the United States, except those systems used by U.S. Government agencies, are regulated. The FCC Rules and Regulations contain most of the information which the planner requires to prepare him for licensing of his proposed radio stations. The planner therefore should familiarize himself with the FCC Rules and Regulations or consult with others who are knowledgeable of their contents.

(3) FAA Coordination

The limitations for the erection of an antenna at a height above existing structures are specified in the FCC Rules and Regulations. These limitations are designed to minimize obstructions to the flight of aircraft around airports. Similar limitations and regulations may also be imposed by the state through its division of aviation or equivalent office.

If the new antenna does not extend above an existing antenna, the presence of the existing antenna should not be construed as conclusive evidence that coordination with FAA offices or state offices is not required. Documented evidence of FAA and state coordination for the existing antenna should be obtained and the coordination performed if there is any doubt.

(4) Federal Statutory Considerations

Programs which include Federal financial assistance are subject to the provisions of certain Federal laws. Principal among these are the following which the planner should include as major considerations.

- *Intergovernmental Cooperation Act of 1968* – The provisions include the notification of the A-95 Clearinghouse (Ref. 14) of the intention to apply for Federal grant funds.

- *National Environmental Policy Act of 1969* – The filing of an environmental statement and/or analysis for programs that include new construction, renovations that lead to an increased occupancy of 25 or more persons, programs that include microwave or radiation, and programs that otherwise impact on the environment.

- *Clean Air Act (P.L. 91-604) and Federal Water Pollution Control Act (P.L. 92-500)* – Includes filing an environmental statement.

- *National Historic Preservation Act of 1966* – The National Register of Historic Places must be consulted to determine the effect of the program on the protection and preservation of national historic districts, sites, buildings, structures or objects.

- *Uniform Relocation and Real Property Acquisition Act of 1970* – Determines fair and equitable practices for persons displaced or property acquired by Federally assisted programs.

- *Federal Freedom of Information Act* – Provisions for making available to the public and press information that is not exempt by state or Federal law.

- *Title VI of the Civil Rights Act of 1964* – No person shall, on the grounds of race, color, creed, sex or national origin, be excluded from participation in, or denied the benefits from, any program which receives Federal assistance.

- *Contract Work Hours and Safety Standards Act (40 U.S.C. 327-330) and U.S. Department of Labor Regulations (29 CFR, Part 5)* – For construction projects, wages are computed on the basis of an 8-hour work day and a standard 40-hour week. No construction laborer or mechanic is required to work under conditions which are unsanitary, hazardous or dangerous to health and safety.

- *Occupational Safety and Health Administration (OSHA)* – While Federal regulations under OSHA do not apply directly to employees of state or local governments, some states have adopted these or similar regulations. The planner should confer with his state Department of Labor for applicable rules and regulations regarding local government safety and health requirements. Radio towers constructed or maintained by commercial firms must comply with the Occupational Safety and Health Act of 1970, as administered by OSHA.

(5) LEAA Instructions

The instructions of the Law Enforcement Assistance Administration (Ref. 15) which pertain to projects assisted by LEAA funds are usually made available by the office in state government responsible for administering such funds. These instructions often are incorporated specifically in the terms of the applicable grant. Such instructions, whether specifically set forth or invoked by reference, become part of a contract between the state and the local governments when the grant of funds is authorized and accepted.

Typical provisions of such instructions pertain to the administration of the project (Ref. 16), for example, advertisement of bids, method of contract award, financial and status reports, and evaluation requirements. They may also pertain to specific technical provisions, such as conformance with a state telecommunications plan.

(6) State Statutes and Local Ordinances

State statutory provisions pertinent to telecommunications are available with the assistance of one who is conversant with the state annotated code. These provisions can range from those that govern the joint action of several jurisdictions in an undertaking, such as establishment of a facility and an organization for consolidated dispatching, to tariff provisions and limitations on the use of microwave systems. The prudent designer should seek the assistance of legal counsel available in governmental offices.

Local zoning restrictions, building ordinances, and electrical codes will be pertinent also, particularly if a structure is to be erected or even if an emergency power supply unit is to be installed in an existing building. The structure of the local government is likely to suggest an office that is cognizant of such matters. A local engineer and architect may be a useful source of such data. The office of the Chief Engineer of the state Public Utility Commission should be consulted for technical and regulatory considerations.

6. DETERMINING CONCURRENCE WITH OTHER PLANS

The planner should next determine whether the alternative concepts are compatible with the plans of contiguous state and regional agencies. If a concept is not compatible with the technical, operational, and scheduling provisions of these plans, it is unlikely that funds will be approved to implement the project, nor will full benefit be derived by the project. Several plans that exist in all or most states are discussed below.

(1) State Comprehensive Plan

Annually, each state participating in the program of funding assistance administered by LEAA is obligated under law to submit a Comprehensive Plan (Ref. 4). This plan sets forth the objectives, priorities, planned projects, and overall plans for improving criminal justice activities in the state.

Many states have incorporated specific law enforcement telecommunications plans within their Comprehensive Plan, or alternatively, have incorporated specific requirements and/or conditions for eligibility for a telecommunications grant. The planner must therefore check for compatibility with the Comprehensive Plan if he desires LEAA funding. He should also determine that his program is covered under existing communications project priorities and needs contained within the Comprehensive Plan. If this is not the case, it may be necessary for the local planner to coordinate with the regional or state LEAA planner for incorporation of his project in a subsequent fiscal year.

(2) State Telecommunications Plans

A number of states have developed statewide telecommunications plans which incorporate law enforcement telecommunications considerations. Some LEAA state planning agencies have incorporated these telecommunications plans by reference as part of their comprehensive plans. Such plans may contain any of the elements

shown in Table 11. They may apply to state agencies only or to law enforcement agencies at the state, county, and municipal levels.

Table 11
Areas Addressed in Many State Telecommunications Plans

Organization of radio networks
Interagency coordination
Spectrum management
Citizen access
Frequency allocations and frequency coordination
Cooperative or consolidated dispatching
Interstate coordination
Data retrieval systems
Procurement procedures
Maintenance plans
Financial considerations
Operational requirements
Configuration control
Disaster operations
Reliability standards
Telephone networks
Engineering

Almost all the state telecommunications plans are advisory with respect to local law enforcement agencies. However, concurrence in whole or in part is often required to qualify for LEAA funding. Even where such concurrence is not required, maximum benefit from the planned project will be derived by reference to the state plan.

The local planner is therefore encouraged to coordinate his planning efforts with the state planner, and equally as important, the state planner is encouraged to coordinate with the local planners in the preparation, implementation, and updating of the state plan.

Having compared each alternative concept with the state plan, the planner should consider modification of the concept in those areas where it differs from the state plan.

(3) National Standards and Goals

The next step in the concept evaluation process is to compare each concept for conformance with the National Standards and Goals as reported by the National Advisory Commission on Criminal Justice Standards and Goals (Refs. 5, 6). LEAA has issued a policy statement that will be useful to the planner in placing the National Standards and Goals in their proper context. The LEAA policy statement, issued at the 1974 mid-winter meeting of the state planning agencies in Williamsburg, Virginia, is quoted in part below:

> "The Reports of the National Advisory Commission on Criminal Justice Standards and Goals represent one of the most significant accomplishments of the Law Enforcement Assistance Administration in its first five years of operation. These reports will be of primary importance in determining LEAA policies and in evaluating the efficacy of LEAA programs in the coming years."
>
> "However, it is LEAA policy neither to endorse the Commission's specific recommendations nor mandate acceptance by states and units of local government of the Commission's recommendations. LEAA cannot and will not require incorporation of the Commission's specific standards into a state plan as a condition of its approval of the plan."
>
> "The standards developed by the National Advisory Commission are strictly advisory. It is the standard-setting process which LEAA endorses and not any individual standards."

In evaluating concepts by comparing them for conformance with the National Standards and Goals, the planner should recognize that the Standards and Goals provide helpful guidance in coordinating the objectives and goals of the agency with those of the state plans and national concepts. While this coordination is helpful in securing approval from reviewing authorities, conforming with the National Standards and Goals should not be interpreted as a stamp of approval for the plan or that the planned concept is the most effective concept in meeting the needs of the community. Justifiable local needs are not invalidated simply by their absence from state or national planning documents.

(4) State Standards and Goals

National Standards and Goals should be considered at a state level by giving them greater specificity appropriate to the circumstances of the state. Such state-oriented standards and goals should be developed at the state level and used to minimize telecommunications interface problems throughout the state.

7. DETERMINING SYSTEM ACCEPTABILITY

The system effectiveness of alternate concepts should also be measured in terms of the degree by which the user agencies, the community and the local body of government will find each alternative acceptable to them. This subjective measure is difficult to quantify but its importance to a successful system implementation should not be underestimated. Some of the factors that may be considered in the evaluation of alternatives are listed in the following paragraphs with the realization that local situations may suggest additional factors to the planner.

(1) User Agency Acceptability

The degree to which the public safety agencies that will use the proposed system find the alternative concepts acceptable is of prime importance to the success of the system. Examples of factors against which each alternative should be weighed include the following:

- *System Performance* – Solutions to known operational problems such as incomplete radio coverage, channel congestion, and lack of interagency coordination should be considered.

- *System Cost* – Providing improved telecommunications service at less ownership cost to the agency budget is a strong acceptance factor. The cost of implementation, maintenance and operation must be evaluated.

- *Personnel* – The number of personnel needed, their skill levels and training needs are factors bearing on user agency acceptance.

- *Improved Officer Safety* – An effective telecommunications system will provide improved officer safety and is therefore an important factor in user agency acceptance.

(2) Community Acceptability

The degree to which alternative system concepts provide solutions to public safety problems in the community should be identified and assessed for the selection of a system concept. Some of the factors that give community visibility to public safety agency performance include the following:

- Citizen Safety through improved citizen access to Public Safety Services
- Reduced Theft Losses
- Improved Apprehension Rate
- Public Safety Coordination
- Cost Effectiveness

(3) Local Government Acceptability

The evaluation of alternative concepts should include a measure of the probability of acceptance by the elected body of local government. An understanding of local issues will assist the planner in identifying the local factors that should be considered. The following suggestions may be included in many evaluations:

- *Cost* – The tax-supported public safety agencies are funded from the public treasury and any effect an alternative concept will have upon the tax base should be evaluated
- *Jurisdiction* – The inclusion of more than one jurisdiction in a regional telecommunication system concept implies legal and political consideration by several elected bodies. These impacts should be evaluated in choosing a concept.

(4) Evaluating Acceptability Factors

Concept acceptability is not easily quantified in terms of dollars or other units of measure. In the absence of more substantive numerical methods, a set of dimensionless numbers can be used to provide a means of comparison between competing concepts. For example, such a set could be:

0 = Does not meet the needs

1 = Meets the needs

2 = Meets the needs exceptionally well

When one evaluation item has greater impact on the system effectiveness than do the other evaluation items, a weighting factor can be used to elevate its numeric score and thereby its consideration over that of the other items. Items with different levels of effectiveness are assigned corresponding levels of weighting factors.

In evaluating all competing system concepts, the evaluation criteria must be consistent among the competing concepts and these criteria with their weighting factors must be carefully documented. The weighting factors must be chosen to represent the priorities and judgments of the planner and the agency. To borrow weighting factors from an evaluation by another agency is seldom satisfactory.

8. DOCUMENTATION AND PRESENTATION

All steps taken in evaluating the alternative concepts and all assumptions made should be carefully documented. The level of documentation and the resulting presentation should be tailored to the complexity of the system under evaluation. As a minimum there should be clear evidence that assumptions and conditions were applied equally to all evaluations. The results of cost evaluation and system effectiveness evaluations should be presented along with the conclusions and recommendations.

The means of presenting the data, conclusions, and recommendations will depend in great part on the individual experience of the reviewers of the data. The following paragraphs suggest methods that are often employed successfully:

- *Matrix Presentations* – Rectangular matrix charts are often used to display comparative cost figures for a significant number of similar items associated with each of several competing concepts. Such charts tend to display a large number of numerical values and thereby may partially mask vital comparative relationships.

- *Graphic Presentation* – Graphics are very useful in depicting major comparative evaluations and are less sensitive to absolute values. Bar graphs are useful in visualizing cost comparisons. Line charts can be used to describe complex mathematical relationships, such as the transmitter power versus radio range.

- *Index Numbers* – Subjective evaluations, such as the degree of security for an acceptable system concept, can be assigned dimensionless numbers that indicate the degree of acceptance or rejection relative to other competing concepts. The rule is to use as coarse a measure as possible with the higher numbers representing higher degrees of acceptance. Index numbers are best displayed on a matrix presentation.

The selection of the most applicable alternative concept is a decision that significantly dimensions the final system configuration. A system cost estimate that will identify the level of funds needed to implement the system can now be established with reasonable confidence. The sources of these program funds will be the subject of Chapter VII.

CHECKLIST

VI. DEVELOPING, EVALUATING AND SELECTING FROM ALTERNATIVE CONCEPTS

1. Have all resources been used to develop alternative concepts? ☐

   Have subsystem alternatives been developed? ____

   Have system users been consulted? ____

   Have similar systems been examined? ____

   Has the literature been searched? ____

2. Have the goals and objectives been used as an evaluation criteria for the alternatives? ☐

3. Has operational compatibility been used as an evaluation criteria? ☐

   Compatible with agency operations? ____

   Compatible with interagency coordination? ____

4. Has technical feasibility been used as an evaluation criteria for alternative concepts? ☐

   Uses available components? ____

   Are needed telephone trunks available? ____

   Is the propagation model feasible? ____

5. Has the cost of each alternative been an evaluation criteria? ☐

   Investment cost analysis complete? ____

   Operating cost analysis complete? ____

   Cost saving analysis complete? ____

   Cost-benefit analysis complete? ____

6. Have legal considerations been an evaluation criteria for each alternative? ☐

   Conformance with Federal regulations? ____

   Conformance with LEAA guidelines? ____

   Conformance with state law? ____

   Conformation with local ordinances? ____

7. Has the concurrence with other plans been considered in the evaluation of alternatives? ☐

   With state Comprehensive Law Enforcement Plan? ____

   With state telecommunications plan? ____

   With state standards and goals? ____

   With national standards and goals? ____

8. Has acceptability of the system been a criteria in evaluation? ☐

   Acceptable to the user agency? ____

   Acceptable to the community? ____

   Acceptable to local government? ____

VII. PROGRAM FUNDING

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Familiarity with all means of local funding, city, state and Federal revenue sharing, grants and the use of bonds will assist in generating a sound fiscal policy for program implementation. Financial planning and analysis is a function that should occupy a prominent position in the program planning organization. Complete funding plans for implementation and operation should be developed at the earliest possible stage of program development so that timely budget requests can be made and appropriate funding applications can be submitted.

1. MUNICIPAL FUNDS

The law enforcement agency is tax supported by the municipal or state government and is not involved in the direct procurement of revenue (Ref. 5). All operating funds flow through the police budget appropriation as indicated in Figure 4. Municipal income levels are usually stable thereby creating strong competition for budget funds among the other municipal departments and among other divisions of the police department.

The telecommunications system's recurring operating costs should be paid by municipal funds and should be an item of the regular budget appropriation. They should be included in the budget requests for the year following the year of system implementation. Grant funds should not be used to implement projects that the agency cannot afford to support.

2. REVENUE SHARING

State government support of local government fiscal responsibilities is frequently given through programs of revenue sharing between the state and local government. The tax mechanism is of two forms:

- Taxes are assessed and collected by the state government and portions of the income are allocated to city, county, and township units.

- Taxes are assessed and collected by local governments and are partially distributed to the state government.

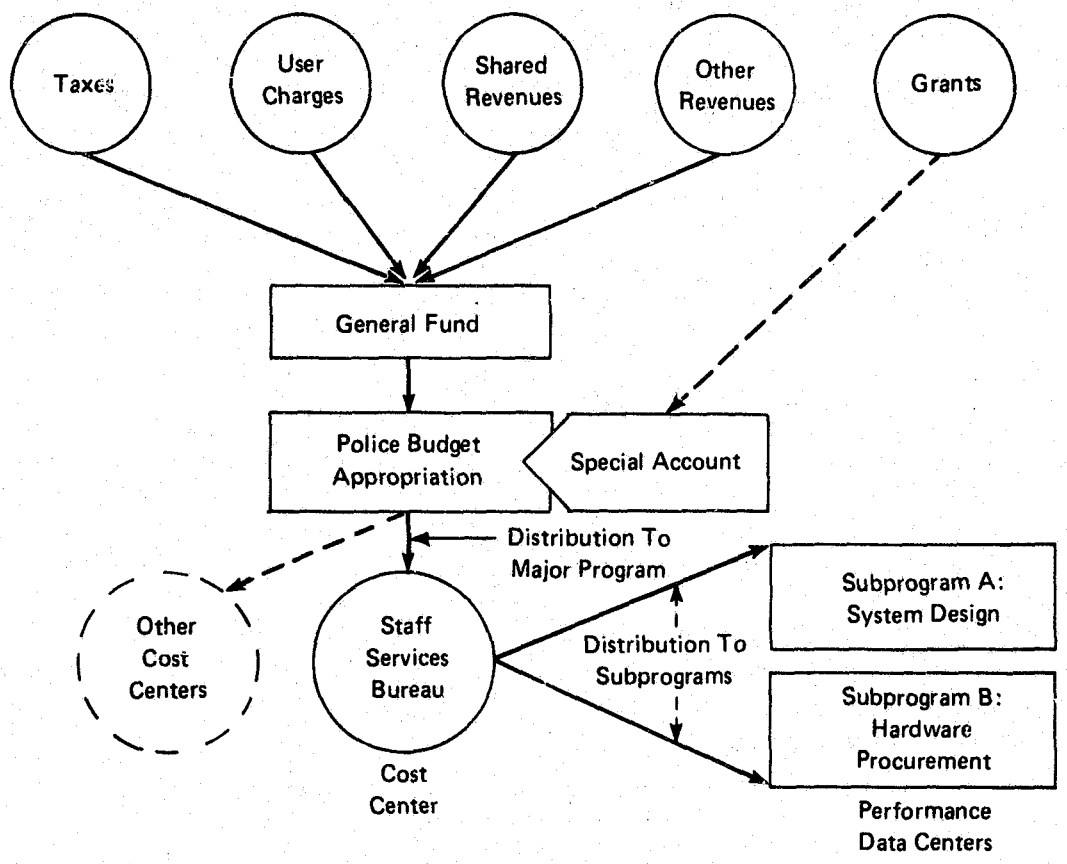

FIGURE 4
Basic Police Budget Structure

Although each state administers the tax and expenditures in a slightly different manner, many states place operational responsibility at the local level while retaining control of administrative policy. To the planner of law enforcement telecommunications systems the implications are that:

- The application for funds will follow published state guidelines for law enforcement or criminal justice programs.
- Programs selected for funding will usually have multi-jurisdictional or statewide public safety or criminal justice scope.

Revenue sharing is based on the usually stable municipal tax base and is probably appropriate for use on a continuing basis for part of the recurring post implementation operating costs of the telecommunications system.

3. STATE GRANTS

State grants-in-aid to local law enforcement and public safety programs have the same economic effect on local government as do the revenue sharing programs. The amount of money available to be allocated is determined by tax collections in both cases.

Grants-in-aid tie the shared taxes to specific programs. In making application for state grants-in-aid, it is apparent that the successful award of these funds will follow clearly defined state guidelines for both the scope of the program and the specific use of the funds for recurring or nonrecurring system costs.

Other conditions of the grant will be similar to those of revenue sharing.

4. FEDERAL GRANTS

Traditionally, federal grants that have been awarded were directed to the states rather than to local governments. The state is required to set up programs for the use of these grant funds within the standards laid out in the federal guidelines. In general, federal grants tend to encourage the attainment of suggested national standards (Ref. 5) rather than to equalize state fiscal capacity.

Applications for these grant funds will adhere to state guidelines published by the state agencies responsible for administering the funds. Responsible agencies in each state will provide these guidelines and also the forms to be used by the jurisdictions in making grant applications. It is important that the planner allow ample time in the planning schedule to accommodate the budget cycle of the funding agency. The planner must also

identify local funds to meet any matching fund requirements associated with the grant. Matching fund requirements normally vary from zero to 50 percent of the total project cost. Some of the major sources of federal funding assistance available to the law enforcement telecommunications system planner include the following:

- *Department of Justice* – The Law Enforcement Assistance Administration (LEAA) provides block grants and discretionary grants through state planning agencies under the Omnibus Crime Control and Safe Streets Act of 1968 as amended by the Crime Control Act of 1973.

- *Department of Transportation* – Specific programs that improve highway safety or improve the public safety response to highway accidents should be qualified for funding under the Highway Safety Act of 1968.

- *Department of Defense* – The Defense Civil Preparedness Agency will make grant funds available to facilitate the interface between emergency communications command and control centers and the public safety telecommunications system. Funds are also available to maintain such interface subsystems on a recurring basis.

- *Department of Labor* – Grant funds are available to train operating and maintenance personnel, for the feasibility demonstration of dispatch centers, as an example.

- *Department of Health, Education and Welfare* – Under the Emergency Medical Services System Act of 1973, grant funds are made available to support the interface communications between law enforcement units and the emergency response vehicles and hospitals providing emergency medical services.

Grant funds should be used to initiate programs that the jurisdictions are committed to support following the depletion of outside funding. It is usually inappropriate to plan for the use of grant funds to support post implementation operating costs beyond one year.

5. MUNICIPAL BONDS (Ref. 10)

Bonds are used widely for capital acquisition and capital improvements. These fiscal instruments represent long-term financial obligations, and continued use places the jurisdiction under increasing long-term indebtedness. The consequence of these financial techniques can be serious to the taxpayer. Bond financing has not been used extensively for telecommunications systems.

Of the many possible debt financing techniques, the following general classes display the range of considerations faced by the planner of a law enforcement telecommunications system.

- *Municipal Bond* – Such bonds are backed by the taxing power of the unit of government involved. The issue of the bond usually requires enabling legislation and a referendum approval by as much as two-thirds of the votes cast. The length of time needed to get approval for such funds and the restrictions that inevitably accompany such bond issues makes this funding technique less attractive.

- *Nonprofit Corporation* – A facility that provides service to several jurisdictions can be formed as a nonprofit corporation with the local political subdivisions showing a beneficial interest. Time-consuming enabling legislation may be needed. The bonds issued by such a corporation providing only telecommunications services to local law enforcement agencies will usually have a poor rating in the bond market and consequently receive minimal buying support.

The use of bond financing is subject to endless variations of local laws and ordinances. The planner of a public safety telecommunications system should coordinate his requirements with the senior financial managers of the political jurisdictions if bond financing is contemplated.

A decision should be made regarding the method of funding to be used and the necessary steps taken to acquire that funding. Another decision that will also assist in planning the scope of the effort needed to implement the plan is identification of the method by which the system is to be procured. The factors affecting that decision will be the subject of Chapter VIII.

CHECKLIST

VII. PROGRAM FUNDING

1. Have municipal funding needs been established and included in appropriate budget requests? ☐

2. Has application for State grant funds been made? ☐

3. Has application for Federal LEAA grand funds been made? ☐

4. Have all other sources of Federal funding assistance been explored? ☐

   Department of Defense ___

   Department of Labor ___

   Department of Health, Education and Welfare ___

   Department of Transportation ___

5. Have municipal bonds been considered as a source of funding for the project? ☐

VIII. SELECTING THE PROCUREMENT METHOD

VIII. SELECTING THE PROCUREMENT METHOD

The procurement method chosen will determine, in part, the scope of system design effort by the procuring agency and also determine the responsibility of the procuring agency for system integration and system integrity. The criteria for choosing one procurement method over another is principally the degree of technical skill possessed by the procuring agency and how much responsibility for system performance the procuring agency is willing and able to assume.

Procurement methods can be identified by the technical detail of the system specification required by each. Starting with the least detailed system specification and proceeding to the most technically detailed specification, the procurement methods can be categorized as follows:

- *System Function Specification Method* – Describes only what the system will do. It places the least constraint on hardware and costs and is seldom used alone in public safety system procurements.

- *System Performance Specification Method* – Describes parametrically how well the system shall perform specified functions. It is used where performance can be defined but technical expertise is not available to specify equipment systems certain to provide the needed performance.

- *System Design Specification Method* – Describes equipment characteristics, system configuration, equipment/system testing. A high degree of technical competence is required to successfully employ this method of procurement.

- *Specifying Equipment by Model Number* – This procurement method describes the needed equipment by make, model number or the equivalent. It calls for intimate knowledge of the technical characteristics of available equipment and implies that these characteristics are certain to provide the needed system performance. Suppliers not named in the specifications often take exception to this procurement method.

The characteristics of these specification categories are summarized in Table 12. In the usual procurement, combinations of these categories are used. Typically, characteristics, performance and functions of the equipment and of the system configuration will be sufficiently specified so that the supplier has no alternative in the quality of the equipment to be supplied nor in the functions to be performed.

Table 12
Comparison of Specification Types

Specification Characteristic	Specification Type			
	System Function Specification	System Performance Specification	System Design Specification	Supplier Model Number Specification
What is specified	What the system does	What the system does; how well it does it	System Configuration and System Hardware	System Hardware
Example of a specified item	Voice communication on each of four channels	Voice communication over 95 percent of the area	Solid state, modular construction	Equipment Model XXX or equivalent
When used	Rarely by itself except for research and development	When there is limited technical expertise in the agency	High level of technical expertise in the agency or addition of a few units of a type in use	Addition to existing system to assure compatibility
Responsibility for System Performance	Procuring agency is responsible	Supplier is responsible for equipment characteristics that affect system performance	Procuring agency is responsible	Procuring agency is responsible
Cost of Procurement	May fall within a very wide range	May fall within a moderately wide range	May fall within a narrow range	May fall within a very narrow range
Complexity of Acceptance Test	Go/No-Go testing	Probably require field performance evaluation tests	Will probably require bench tests and field performance tests	Will require only bench acceptance tests
Responsibility for avoiding interference with other agencies	Procuring agency is responsible	Supplier is responsible	Procuring agency is responsible	Procuring agency is responsible

In meeting performance specifications for radio coverage, however, the supplier will also need system details that directly affect radio propagation so that he can be held accountable for radio coverage. Typically the supplier will need:

- Antenna/tower configuration for base stations and satellite receivers – tower location, antenna height, gain, directivity, and location of the tower. The supplier may be required to select from several alternate locations to utilize government property, provide physical security, etc.

- Base and mobile/portable transmitter power

- Mobile and portable antenna gain.

Specification of all equipment and system characteristics that affect radio coverage requires considerable analysis and propagation testing for which the agency may not have the expertise or resources. Engineering design specifications for equipment should be consistent with the performance specifications and should not restrict the supplier in meeting the performance requirement for radio coverage.

1. PROCUREMENT USING SYSTEM FUNCTION SPECIFICATIONS

In public safety telecommunications system procurement the system function specification is seldom used alone. To do so implies that the means of meeting the system function are yet to be developed, and this is not usually the case in public safety telecommunications. Function specifications provide an essential introductory statement to performance or equipment specifications. Such recitals of functions are indispensable to a clear understanding by both supplier and procuring agency of the intended method of operation. In a base and mobile system a function specification would indicate, for example:

- Location and functions of telecommunications center

- Telephone access to telecommunications center

- Types of operating positions: dispatchers, complaint operations, and dispatch/complaint operators

- Status displays to be maintained in telecommunications center

- Number of radio channels

- Intended uses of radio channels

- Number of vehicles to be radio equipped
- Access to security alarms, terminals, etc.
- Area of operation of vehicles
- Selective call considerations
- Voice privacy provisions
- Maintenance considerations
- Software needs
- Disaster operations
- Test and acceptance provisions
- Personnel skill considerations.

The responsibility for defining the system functions accurately rests entirely with the procuring agency. Procurements based upon functional specifications usually occur in the realm of research and development where the means of meeting the specified function is not known initially. This type of procurement is not usual in public safety telecommunications. However, when it does occur, the responsibility for developing the methodology to meet the specified functions rests entirely with the contractor. The burden of proof that the system function specifications have been met will usually be borne by the procuring agency.

2. PROCUREMENT USING SYSTEM PERFORMANCE SPECIFICATIONS

The procuring agency will have analyzed its telecommunications system performance needs in significant technical detail to be able to procure using system performance specifications. These needs include, for example, radio channel loading for intradepartmental and interdepartmental operations (including any specialized operations such as surveillance or traffic control), telephone message traffic loads, teletype and hot line requirements, coordination requirements between parts of a jurisdiction and similar needs. This technical analysis should account for the long-range (10 years) trend in changes to these requirements.

In a base and mobile radio system, a performance specification would include as a minimum the following general criteria:

- Minimum radio coverage over the specified geographical area of operation in terms of minimum acceptable signal level.* Coverage over specified road miles may be more appropriate in some cases
- Maximum delay in answering a complaint call (Ref. 5)
- Average delay in obtaining a clear radio channel (Ref. 3)
- Maximum system downtime for fixed facilities in a specified period of time (Ref. 3)
- Maximum repair/replace time for mobile and portable equipment
- Interagency communications coordination requirements
- Channel configurations needed, such as simplex, duplex, mobile relays, repeaters, etc.
- Microwave subsystem interface
- Transmission methods such as voice, data, video and facsimile considerations
- Maximum delay time for field units to receive law enforcement information system data.

The responsibility for meeting the performance specifications rests upon the contractors and suppliers. By placing this responsibility with the suppliers and contractors, the procuring agency must give up some of its control in return for technical expertise.

3. PROCUREMENT USING SYSTEM DESIGN SPECIFICATIONS (Ref. 18)

The system design specification describes the units of equipment to be used in the system, the system configuration, and where, how, and when the equipments are to be installed. It is usually supported by a system function specification that identifies the method of operation of the system.

*Area Coverage of 95 to 97 percent is usually a realizable performance where the minimum usable signal level is 12 db SINAD. (Refs. 3, 17).

The system design specification completely describes, for example, the electrical and mechanical characteristics of the equipment required and specifies the location of an antenna tower, type of antenna to be mounted on the tower, antenna height above ground, type of cable to connect the antenna with the transceiver, and transmitter power to be delivered to the cable. Tables 13 and 14 provide some representative items for equipment specifications but are not intended to be all inclusive for all system design considerations.

Use of system design specifications places on the procuring agency full responsibility for system analysis, design, and for system performance, including the field testing of any equipments not installed by the supplier. If the agency undertakes the installation of the equipment itself, it also must assume the responsibility for equipment interface compatibility. Adequate test equipment must, therefore, be available to the technical staff of the procuring agency, and adequate technical skills must be available from staff personnel.

In developing design specifications, the minimum capability that fully meets requirements should be specified so that savings in cost can be realized. For example, mobile transceivers with eight channels should not be specified when an analysis of future requirements indicates that only four channels will be required for the useful life of the equipment.

The specifications of design characteristics such as selectivity and spurious and image frequency rejection are less straightforward because the trade-offs are much more difficult to evaluate. Therefore, specifications tend to define the quality of standard equipment that can satisfy the specifications. In all cases, the specifications for these equipment parameters should be technically feasible and the specification should call for verification by standard testing techniques (Ref. 27).

4. PROCUREMENT BY EQUIPMENT MODEL NUMBER

Procurement of equipment by make and model number, or equivalent, places the entire burden of responsibility for system performance upon the procuring agency. For a system procurement by this method the assumptions made include the following:

- The system design is technically complete and detailed enough to specify individual equipment characteristics needed to accommodate the design parameters.

- The technical characteristics of the equipment specified are certain to meet the system performance needs.

Table 13
Mobile and Portable Equipment Specifications

Transmitter (Refs. 19, 20, 22, 23)

- Frequencies of channels and crystals
- operating frequency range
- Minimum power output
- Frequency stability
- Modulation type (voice, digital)
- Minimum spurious and harmonic emission
- Maximum FM noise
- Maximum distortion
- Minimum frequency spread without degradation of operation

Receiver (Refs. 17, 20, 23)

- Frequencies of channels with crystals
- Operating frequency range
- Minimum sensitivity
- Minimum selectivity
- Maximum intermodulation
- Minimum spurious and image rejection
- Maximum audio distortion
- Minimum audio output
- Minimum frequency spread
- Modulation acceptance (voice, digital)
- Channel scanning and priority features, if appropriate

Design Features

- Total number of channels
- External dimensions (weight, finish)
- Tone code squelch if appropriate and tone frequency
- Selective signaling provisions (Ref. 21)
- Use of vacuum tubes or solid state devices
- Nominal supply voltage
- Fuses
- Degree of modular circuit construction
- Type of printed wiring circuit boards
- Method of removal and replacement of circuit boards and frequency determining elements
- Type of mounting and locking fasteners
- Accessibility of metering sockets and tuning adjustments
- Antenna gain, method of mounting, type of antenna cable
- Use of scramblers
- Environmental Requirements

Table 14
Base Station Specifications (Ref. 24)

Requirements of Table 13 Apply

Additional Requirements for Transmitter/Receivers
- Repeater operation, if appropriate
- Remote control
  - Wire line and/or radio control characteristics
  - Tone or D.C. control
  - Location of control points
- Cabinets and enclosures

Additional Requirements for Towers and Antennas if Appropriate (Ref. 25)
- Tower type, use of guys or self-supporting
- Maximum departure from true vertical
- Wind load capacity
- Lighting
- Lightning protection
- Combiners/Duplexers

Additional Requirements for Emergency Power Unit, if Appropriate (Ref. 26)
- Maximum amount of power
- Nominal voltage and frequency
- Automatic or manual start
- Fuel type
- Fuel storage capacity-method of delivery of gaseous fuel
- Location
- Protection from weather or type of shelter.

- The procuring agency is aware of and has evaluated the technical characteristics of other available and competing equipments.

- The procuring agency has the skill to provide its own system integration and system test functions.

This method of procurement has utility for small procurements where additional units are to be added to an existing system composed of the same make and model. Compatibility should be considered in these cases. This method is also valid where special interface circuitry is available from only one known supplier, for example, an internal modem in a unit of high-speed data peripheral equipment.

The method of procurement should be chosen to accommodate the size of the system being procured, the capability and willingness of the procuring agency to assume technical responsibility, and any unique needs of the system performance specifications. Having decided on the method of procurement, the amount of detail needed from the system design effort has been determined. The approach to these system design factors will be the subject of Chapter IX.

CHECKLIST

VIII. SELECTING THE PROCUREMENT METHOD

1. Has a system function specification been prepared for system procurement? ☐

2. Have the needs of the system been analyzed to determine if a system performance specification is adequate for system procurement? ☐

3. Will system needs require the development of a detailed system specification for procurement? ☐

4. Can the system be procured by specifying the make and model number of the equipment? ☐

5. Is the system procurement specification compatible with the size and complexity of the system to be procured? ☐

IX. DEFINING THE ENVIRONMENT AND DEVELOPING FINAL SYSTEM DESIGN

IX. DEFINING THE ENVIRONMENT AND DEVELOPING FINAL SYSTEM DESIGN

Refinement and further analysis of the selected systems concept is required to develop the final system design. Previous work in identifying and evaluating alternative concepts and in selecting the concept will have already established many of the design parameters. These parameters, as well as greater design detail of the system configuration and of each element of the system, must be examined and developed in final form prior to development of procurement specifications. The scope of this analysis should be compatible with the size of the system design or modification. Specialized professional assistance should be considered for large or complex system designs.

Finalization of the system design will involve the following considerations:

- Define the environment
- Develop detailed system configuration
- Determine requirements for new frequencies
- Apply for frequency licenses
- Finalize interface parameters
- Finalize hardware parameters
- Establish maintenance needs
- Finalize facilities needs
- Finalize software parameters
- Establish personnel needs
- Establish training needs
- Establish financial needs.

This chapter addresses these considerations in developing the design of the chosen alternative system concept.

1. DEFINING THE ENVIRONMENT

The telecommunications system being planned will usually complement an existing system environment and an existing operational environment. To be successfully implemented, the new system must be reasonably compatible with these environments. The planner should take deliberate action to identify and document the elements of these environments. A large amount of this information will be found in the data base.

(1) System Environment

The system environment is defined as those elements that relate to the equipment and facilities of the existing system configuration. The identity of these elements will vary widely among the existing systems, but some of the more commonly experienced elements could include the following, for example:

- Power sources (routine and emergency)
- State and regional law enforcement information system terminal interface
- Expansion provisions of existing integrated dispatching center consoles
- Spare channels on existing microwave system links
- Telephone trunk line availability
- Existing regional network coordination channels
- Ownership, or access to, existing antenna tower sites.

Many other appropriate elements must be considered in defining the system environment of the current telecommunications configuration.

(2) Operational Environment

The operational environment is defined as being those elements related to the man-machine interface of the existing system operations. As an example, the following elements can be found in public-safety operational environments:

- Existing multiagency mutual-aid agreements
- Level of dispatcher training and retraining
- Number and skill levels of available personnel
- Variances in operating policy and procedures among participating agencies
- Maintenance procedures available
- Variances in the level of security exercised by the participating agencies.

The elements of system environment, once documented and understood, will form much of the foundation for the design of the proposed system configuration.

2. DEVELOPING THE SYSTEM CONFIGURATION

The system hardware configuration identifies all system components, their location, the communications links, frequencies, and interfaces. The configuration will have been defined in general terms during early planning tasks; now the planner must further refine the design by providing greater detail.

A system chart, such as illustrated in Figure 5, is useful in displaying the system configuration. This diagram is oversimplified, but it serves to illustrate the approach in detailing the system configuration.

3. SETTING CHANNEL AND FREQUENCY NEEDS

The planner should start the procedure for the acquisition of radio station licenses as soon as the need for revisions in station licenses, new station licenses or new radio frequencies is established. The following steps should be considered in establishing these requirements:

- *Existing Frequency Resources* – The planner should review the inventory of the existing radio frequencies in the planning region. This inventory is contained in the planner's data base.

- *Modification of Existing Frequency Resources* – The planner should make maximum use of the existing licensed frequencies in the planning region by modification of existing licenses but not at the expense of system performance.

- *Determination of New License Requirements* – The differences in frequency requirements between the plan and the existing resources represent new frequency requirements that must be licensed. From this comparison the planner can determine the number of VHF low band, VHF high band, UHF band, and microwave frequencies required as well as the mode of operation (i.e., simplex, mobile relay, etc.).

4. RADIO FREQUENCY ASSIGNMENTS AND LICENSING

The Federal Communications Commission allocates and authorizes radio frequencies for use by public safety radio services. These frequencies must be shared, and therefore, will not necessarily be available exclusively to any one entity. All applicants for, and users of stations in these services must cooperate in the selection and use of designated frequencies to minimize interference and to make effective use of the frequencies authorized.

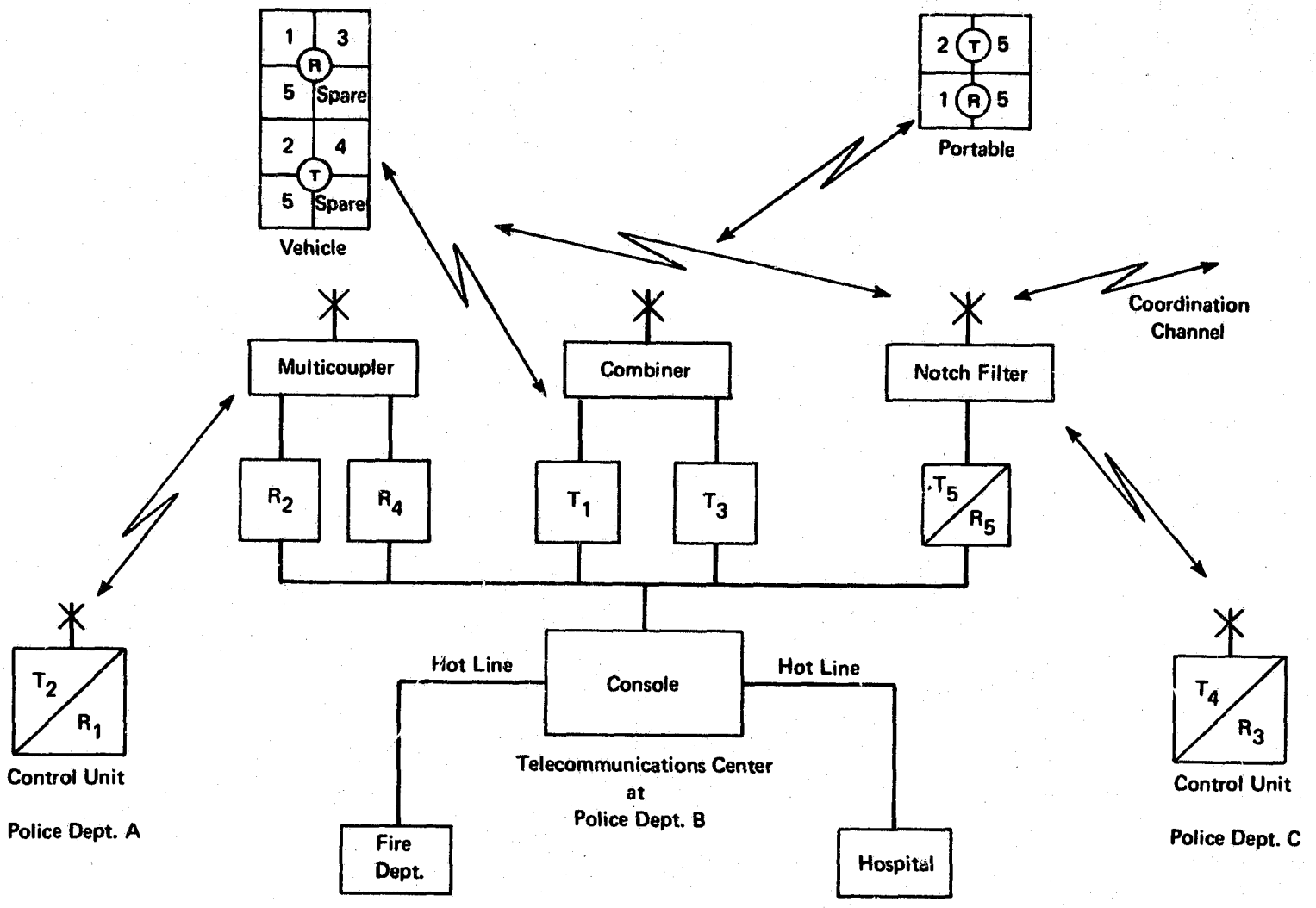

FIGURE 5
Simplified Typical System Configuration Chart

General guidelines* for making application to the Federal Communications Commission are contained in Appendix D. There are separate guidelines in Appendix D for applicants in the Chicago Regional Area where a new approach to spectrum management is being tested.

The following actions briefly describe the five basic steps involved in making application for a land mobile frequency license:

- Determination of system requirements
- Filing a letter of intent with the FCC
- Selection of frequencies**
- Frequency coordination**
- Submission of the application.

The procedures described below do not apply to the 470-512 MHz band or the new emerging 900 MHz band. Organizations contemplating use of frequencies in these two bands would do well to seek professional assistance.

(1) Determination of System Requirements

One of the first tasks for the applicant is to define his communications requirements and his need for modification of station licenses or the issuance of new station licenses. The applicant will be required to provide in his application justification for the frequencies requested, indicating the intended use of the frequencies, channel loading, and the spectrum environment in the area. The system should use as few frequencies as possible. Detailed discussions of system requirements are contained in Chapters IV and V of this document.

(2) Filing a Letter of Intent

The Federal Communications Commission*** can be of major assistance to the planner. The personnel of the commission are available for consultation. A letter of intent, filed early, outlining the system concept and the spectrum resources needed,

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*The guidelines in Appendix D are a summary of guidelines issued on May 6, 1975 by LEAA to each of the LEAA regional and State Planning Agencies.

**It is important to note that neither selection of frequencies nor frequency coordination is mandatory in the Chicago District.

***Applicants outside the Chicago Regional Area should contact: Federal Communications Commission, Washington, D.C. 200554. Applicants within the Chicago Regional Area should contact: Federal Communications Commission, Chicago Regional Center, Park Ridge, Illinois 60068.

will give the FCC personnel the information needed for a preliminary review. After submission, the planner should contact the Commission for its comments and consultation.

(3) Selection of Frequencies

Except in the Chicago District, it is the responsibility of the applicant to select and request the frequency or frequencies desired with evidence of frequency coordination. In the Chicago District, the planner may request the commission to recommend a frequency prior to filing an application.

The FCC Rules and Regulations identify the frequencies authorized for law enforcement communications systems.

The planner should determine the existing frequency usage in the area. The APCO Frequency Advisory Coordinator can be of assistance both for determining existing frequency usage and the desirability of specific frequencies.

License files are maintained by the FCC and are available for public inspection. Lists are also available from private commercial companies who furnish the information for a fee. In the Chicago District, the license files are computerized and the information is readily retrieved through computer terminals at the FCC Chicago Regional Center.

The most positive method of determining the desirability of a frequency is by monitoring the spectrum region of the intended operation with electronic equipment.

(4) Frequency Coordination

The FCC Rules and Regulations require that applications requesting new stations or frequencies, addition of a station to an existing system or modification of existing facilities be accompanied by evidence of frequency coordination, except in the Chicago District. This requirement can be met by submission of 1) an APCO Frequency Advisory Committee recommendation, or 2) a field study report.

1. APCO Frequency Advisory Committee

APCO has the prime responsibility to provide frequency advisory service in the Police Radio Service and shares this responsibility in the Local Government Radio Service. The planner should contact the APCO Frequency

Advisory Committee (APCO Coordinator) and then submit a "Request for Frequency Coordination" to the APCO Coordinator and provide the system design details as required on the request form. A statement from the APCO Frequency Advisory Committee recommending the frequency that, in the opinion of the committee, will result in the least amount of interference to existing stations is submitted to the FCC with the license application.

It should be noted that a Frequency Advisory Committee recommendation cannot be considered as a grant or authorization for any frequency. Neither the committee recommendation nor the field study report can be considered as binding upon either the applicant or the FCC.

2. Field Study Report

Frequency coordination can alternately be accomplished by the submission of a report based on a field study as discussed in the FCC Rules and Regulations indicating the degree of probable interference to existing stations operating on the same channel within 75 miles of the proposed station and by a signed statement that all existing co-channel licensees within 75 miles of the proposed stations have been notified of applicant's intention to file his application. Also required is a report based on a field study indicating the degree of probable interference to existing stations located 10 to 35 miles from the proposed station operating on a frequency within 15 kHz and a signed statement that the licensees of all such stations have been notified of the applicant's intention to file his application. If existing adjacent channel users are located within 10 miles from the proposed station, another frequency should be selected.

(5) Other Coordination Requirements

The proposed erection of antenna towers and supporting structures, remote transmitter site buildings and associated transmission lines or control lines often requires coordination with other governmental agencies.

- *Federal Aviation Administration (FAA) Coordination* – The FCC Rules and Regulations also cover the construction, marking, and lighting of antenna structures. These rules were developed in conjunction with the FAA to prescribe certain procedures and standards with respect to the consideration of proposed antenna structures which will serve as a guide to persons intending to apply for radio system licenses. If in accordance with the standards set forth, it is determined that the proposed antenna

will present a possible hazard to air navigation, a Notice of Proposed Construction or Alteration should be filed with the FAA. The planner should contact the nearest FAA office to obtain the appropriate forms.

- *U.S. Forest Service/Bureau of Land Management Coordination* – Should any facilities be contemplated at a location on any U.S. Government lands under the jurisdiction of the U.S. Forest Service or the Bureau of Land Management, coordination must be effected through the U.S. Forest Service, U.S. Department of Agriculture, or the Bureau of Land Management, U.S. Department of Interior.

- *Environmental Impact Statement* – Facilities which involve the installation of towers in wilderness areas, towers in excess of 300 feet in height, or facilities located in areas which are recognized either nationally or locally for their special scenic or recreational value must be reported to the FCC in an environmental impact statement.

(6) Submission of the Application

Applications should be prepared in accordance with guidelines contained in Appendix D and in accordance with the instructions accompanying the application forms. The applications should be mailed to the Federal Communications Commission in Washington, D.C., or Chicago, Illinois at the addresses provided earlier in this section.

5. FINALIZING INTERFACE PARAMETERS

The interface with other systems was defined when the system environment was documented. The external systems to be interfaced by a public-safety telecommunications system will depend upon the multi-jurisdictional nature of the system, its size and assigned responsibilities. An example of public-safety systems to be interfaced should include but not be limited to the following:

- 911 emergency telephone system
- Emergency medical service
- Intrastate law enforcement information systems
- Regional mutual aid systems
- Local intrusion alarm systems
- Local fire systems
- National Crime Information Center
- National Law Enforcement Teletype System
- Civil Preparedness alarm and alerting systems.

These systems, and any other established systems, will have documented interface characteristics which must be accommodated in the system design.

6. FINALIZING HARDWARE PARAMETERS

Additional analyses are required in order to define the telecommunications system in terms of the hardware items needed to implement the system. Table 15 lists the common equipments normally required and indicates the design parameters and considerations for each type of equipment. The analyses required to establish these design parameters are also indicated in the table and must be accomplished in order to adequately define the equipment requirement prior to development of specifications.

7. ESTABLISHING MAINTENANCE NEEDS

The documentation of hardware items and their characteristics will provide the data needed to estimate the maintenance needs for the new system. The new system will contain items similar in function and complexity to those in the existing system. The past maintenance experience on those items will serve as a basis for estimating the needs of the new system.

The data base should provide maintenance cost data for use in this planning phase. Additional maintenance data and cost data acquired in this study should be used to update that portion of the data base.

8. FINALIZING FACILITY NEEDS

The identification of the telecommunications system in terms of functions and location of functions in the system configuration enables the planner to define facility requirements to support the system. The major facilities that will be required in the telecommunications system are discussed in the paragraphs that follow.

(1) Dispatch Centers

The system configuration defines the number of dispatching consoles, supervisory consoles, and complaint operator consoles for each dispatch center. Design considerations include normal, peak and disaster operations. Design factors relevant to the dispatch center include:

Table 15
System Design Analysis Relating To Hardware Systems

System Design Parameters or Consideration	Required Analytic and Design Approach	Base Stations	Mobile Units	Portables	Antennas	Towers	Filters, Duplexers	RF Control Units	Microwave	Pagers	Dispatch Consoles	Complaint Consoles	Logging Recorder	Emergency Power
Frequencies of Operation	From frequency coordination and system concept	X	X	X	X			X	X	X	X			
No. of Channels	From analysis of projected radio traffic and analysis of command and control functions	X	X	X				X	X	X	X		X	
Output Power	From propagation analysis and coverage requirements	X	X	X				X	X					
Equipment Options . Tone squelch . Channel search . Selective call . Modes . Others	From command and control analysis, system concept, operational analysis	X	X	X				X	X	X				X
Location	From propagation analysis, site/facility survey and operational analysis	X			X	X		X	X		X	X	X	X
Power Gain	From propagation analysis and coverage requirements				X				X					
Height Parameters	From propagation analysis and coverage requirements				X	X			X					
Direction Pattern	From coverage requirements				X				X					
Filter Parameters	From intermodulation, receiver desensitization and transmitter noise analyses						X							
Bandpass Requirements	From frequency spread	X	X	X	X		X	X	X					
Multiplex	From channel requirements and operational analysis						X		X					
No. of Telephone Lines	From analysis of projected emergency and administrative calls	X							X		X	X	X	
Alarms	From operational analysis of concept										X	X	X	
Display	From operational analysis										X	X		
Priority Override	From operational analysis										X	X		
Power Requirement	From electrical analysis of command center equipment	X						X	X		X	X		X

- *Space* – Adequate space in the dispatching room will allow easy coordination between consoles without crowding. Room must be provided around all sides of the consoles for maintenance and removal of any subassembly without prior removal of any other subassembly.

- *Utilities* – The dispatch center and auxiliary rooms for the staff must have adequate power, heat, air-conditioning, light, water, and sanitation.

- *Construction Method* – False floor and ceiling construction will enable power, signal wiring, and utility distribution without clutter.

- *Status Displays* – Lighted status displays of all public-service resources available to the dispatchers should be provided and be visible to all positions in the dispatching room.

- *Information Terminals* – Terminals connecting the dispatcher to Criminal Justice Information System (CJIS) data banks and motor vehicle/driver's license banks should be available to dispatchers.

- *Record Room* – Adequate auxiliary space should be provided for supplies and storage of records.

- *Auxiliary Rooms* – Provisions should be made for off-watch comfort of the staff.

- *Conveyor Systems* – A rapid and accurate method of transferring information from the complaint operator to the dispatcher must be provided.

- *Computers* – If computers are used for message switching or for aiding in dispatching, they may require special air-conditioned facilities with false floors and ceilings.

- *Sound Conditioning* – The dispatching room should be sound conditioned to reduce distracting noise pollution and operator fatigue.

- *Physical Security* – The dispatch center should have limited controlled access and should be constructed with bullet-proof materials.

- *Emergency Power* – An emergency power unit should be provided in the event of primary power failure.

(2) Maintenance Shop

Maintenance can be performed by either a contract arrangement or in-house staff. In either event, adequate bench and storage space should be provided at a location convenient to the dispatch center to accommodate timely malfunction repair and minimize equipment downtime. Requirements to be considered are:

- *Bench Space* – Adequate space to work on the largest subassembly in the center plus locked storage place for needed standard or special tools
- *Tools* – Standard tools and special tools recommended by the manufacturer of the electronic components
- *Storage Space* – Adequate locked space for spare parts and spare subassemblies or equipment
- *Test Equipment* – Standard and special test equipment recommended by the electronic equipment manufacturer
- *Vehicle Facilities* – If mobile radios are maintained by the maintenance shop, suitably heated, lighted and protected facilities must be provided for work on the mobile radio in the vehicle. This facility may also require a vehicle lift system to expedite work on the control cabling system in the vehicle. An adequate vehicle exhaust provision will be required in the garage.

(3) Remote Base Station

Remote base stations are normally located near the antenna site. They are connected to the dispatch center by telephone line or radio control links. Some facilities required are:

- *Building* – A brick or concrete building that provides protection to the equipment should be favorably considered since those materials are not easily penetrated by unauthorized personnel, and require minimal maintenance.
- *Space* – Adequate space for all transmitters, control equipment, emergency power equipment, and maintenance bench. There must be room on all sides of the electronic and power equipment to allow maintenance.

- *Utilities* – Primary power, light, and heat to maintain electronic equipment within its operating temperature range. Ventilation and temperature-activated electric fans can be used to reduce heat build-up inside the building in the summer.

- *Security* – Securely locked building without ground level windows to prevent unauthorized penetration. Intrusion alarms can be added to the control link system.

- *Emergency Power* – Full emergency power motor generator with automatic start-up.

(4) Repeater Stations/Microwave Stations

Repeater stations and microwave stations are located at the base of the antenna tower for each station. The factors relative to those remote stations are the same as those of remote base station facilities except that emergency power can alternatively be provided by a rechargeable battery supply.

(5) Real Estate and Buildings

The planner must make provisions for acquiring real estate, buildings, and right-of-way easements for all dispatch centers, remote transmitter sites, and all antenna tower locations. Buildings must be purchased, leased, or constructed. All antenna tower foundations must be constructed prior to delivery of towers, and access roads to remote sites must be provided.

(6) Vehicles

The number and types of vehicles which will require installation of communications equipment or modification of existing equipment should be identified. Other factors relating to the vehicles include:

- *Space* – Adequate space must be provided for the equipment with consideration given to the convenience of the driver and passengers and to the presence of existing equipment.

- *Power* – Adequate power must be provided to operate the equipment.

- *Mounting* – Consideration should be given to any special mounting requirements.

9. FINALIZING SOFTWARE PARAMETERS

System plans which include automated subsystems will require definition of the associated software. The software must be designed consistent with the functional requirements of the system and include the following considerations as appropriate:

- *Computer-Assisted Dispatch* – Software required for the real-time processing of dispatch information
- *Message Routing* – Software required for the routing of digital messages between fixed terminals, mobile terminals, consoles, and Criminal Justice Information Systems (CJIS)
- *Interface with CJIS* – Software required for the entry and retrieval of data from CJIS including required message formatting
- *Display System* – Software necessary to provide required information to display systems
- *Resource Allocation* – Software required to perform analysis and computation of algorithms to identify optimum allocation of law enforcement resources
- *Statistical Data* – Software required to retrieve, analyze and present statistical summaries of law enforcement activities.

Software needs also include technical, operational, and installation information related to the system hardware. Each hardware item should be supported by appropriate manuals and documentation.

- *Maintenance Manuals* – Technical data needed for the maintenance and repair of hardware items
- *Operating Manuals* – Instructions for the operating personnel of all subsystems, particularly the control consoles and recording subsystems
- *Installation Data* – Technical data for installation of fixed-station equipment including power needs, cooling and space for maintenance access
- *Training Manuals* – Documentation and texts needed for training operating personnel and maintenance personnel.

10. ESTABLISHING PERSONNEL NEEDS

System personnel requirements must be included in the planner's definition of the system as part of the overall design. Some factors to be considered include:

(1) Dispatchers and Complaint Operators

One position manned 24 hours a day will require approximately five full-time trained personnel. This estimate accounts for vacations, holidays, sick leave, and personal leave.*

(2) Dispatch Supervisor

Provisions should be made for a minimum of one dispatch supervisor. Large dispatch centers may require dispatch supervisors for all shifts.

(3) Maintenance Personnel

Overall system maintenance may be accomplished either by a contractor or by an in-house staff. Contract maintenance is a viable alternative if a qualified service company is available locally and can provide rapid service necessary for an emergency system. The planner should perform a cost-benefit analysis before selecting the maintenance approach. Maintenance personnel required for an in-house staff include radio technicians, a supervisor, and a clerk to maintain maintenance records and documentation.

(4) Staff Services

Telecommunications systems generate volumes of data for the management of the system, system evaluation, and satisfaction of legal and financial procedures. For large telecommunications systems, this specialized field requires the full-time attention of personnel specially trained in accumulating the data, recording and filing the data, and preparing reports in the correct format. For a smaller system, a part-time reporting of system performance would be adequate.

*For example, one 365-day year has 8760 hours of time. One worker employed 40 hours a week totals 2080 labor hours a year. Allowing 80 hours annual vacation, 80 hours of annual sick leave and personal leave, and a nominal 48 hours of holiday time, one worker will contribute 1872 hours of labor. It requires 4.68 workers to equal 8760 annual hours.

(5) Management

An integrated system involving several agencies in a large telecommunications network will require one full-time senior manager responsible for technical performance, operational performance, business performance and liaison with political and public safety operations. This person will require full-time clerical support.

For the smaller system, with one member or a limited number of members, the manager of staff services for the major participating agency or the manager of telecommunications for the major agency could provide management for the proposed system.

11. ESTABLISHING TRAINING NEEDS

The planner should include schedules and costs for two basic types of training required by the planned telecommunications system.

(1) Implementation Training

The personnel who operate and maintain the system will require training in the following areas prior to implementation or immediately thereafter.

- *Dispatching Consoles* – Training by the hardware contractor for all duty and reserve dispatchers and supervisors
- *Complaint Console* – Training by the hardware contractor for all duty and reserve complaint operators, dispatchers, and telecommunications center supervisors
- *Computer Terminals* – Training for all telecommunications center personnel in the operation and management of all terminals that facilitate the telecommunications center
- *Recorder Systems* – Training for all telecommunications center personnel in the operation and use of all recording subsystems
- *Maintenance* – Training of all maintenance technicians by the hardware contractors of all mobile, portable, repeater/relay, base station, and console equipment

- *Operations and Procedures* – Training of all operations personnel in operational procedures and in the correct operational use of the mobile, portable, relay, and recorder systems.

(2) Periodic Training

Following implementation, updating and refresher courses should be considered for the system personnel in order to maintain or improve efficient use of the system. Replacement personnel must be trained to accommodate personnel promotion or attrition. All areas listed in the preceding section should be included in periodic training schedules including training materials updated to reflect operation experience.

12. ESTABLISHING FINANCIAL NEEDS

The budgetary cost estimates made earlier in the planning process should be reviewed and updated to reflect the modifications and more detailed data now available. Using the latest system definition, the planner should again accumulate updated cost information in the following areas:

- *Hardware* – Standard costs for all fixed, mobile, portable hardware items including telecommunications center consoles, ancillaries, antennas, and towers
- *Software* – Operating, training, and maintenance documentation including computer or switching programs where applicable
- *Real Estate* – All costs of land, rights-of-way, buildings, and building modifications
- *Personnel* – All costs of salary, overhead, and training of all system operating and maintenance personnel dedicated to the proposed system
- *Financial Costs* – All costs relative to the acquisition of adequate financing to implement the system.

As the system design approaches its final configuration, the scope of the implementation plan will become more evident. Plans should be made for the appointment of a program director who will develop project progress schedules and funding schedules to meet the needs of the system design. The elements of the implementation plan are the subject of Chapter X.

CHECKLIST

IX. DEFINING THE ENVIRONMENT AND DEVELOPING FINAL SYSTEM DESIGN

1. Has the environment been fully identified and documented? ☐

   System environment ____

   Operational environment ____

2. Has the system configuration been documented? ☐

   All components and subsystems identified? ____

   Location of all components and subsystems defined? ____

   All communication links identified? ____

3. Have all new frequency and radio station license needs been identified and documented? ☐

4. Have radio license procedures been initiated? ☐

   Have available frequencies been located? ____

   Has the Frequency Coordinator been notified? ____

   Has a letter of intent been filed with the FCC? ____

   Is a special temporary authority needed to perform field tests prior to filing an application? ____

   Have the PS4-A forms been completed and filed? ____

   Have FCC license forms been acquired? ____

5. Have applications for all needed radio station licenses been filed with the FCC? ☐

   Has a Field Study Report been completed? ____

   Has all coordination been documented? ____

   APCO Frequency Coordinator ____

   Federal Aviation Administration ____

   U.S. Forestry Service ____

   Bureau of Land Management ____

   Occupational Safety and Health Administration ____

   Are Environmental Impact Statements filed? ____

   Have FCC license application forms been submitted with supporting documents? ____

   Has FCC follow-up action been planned? ____

6. Have all system interface characteristics been identified and documented? ☐

7. Have all equipment characteristics and specifications been identified and documented (Table 15)? ☐

8. Have equipment and system maintenance needs been established? ☐

9. Have all facility needs been identified and documented? ☐

   Dispatch centers and base stations ____

   Maintenance shops ____

   Repeaters and microwave stations ____

   Real estate and buildings ____

   Vehicles ____

10. Have system software needs been identified and documented? ☐

- Computer subsystem software ____
- Maintenance software ____
- Operating software ____
- Training software ____
- Installation software ____

11. Have all personnel needs been established? ☐

- Dispatchers and complaint operators ____
- Maintenance personnel ____
- Supporting and management staff ____

12. Have all levels of training needs been identified and documented? ☐

13. Have all levels of financial needs been identified and approved? ☐

- Acquisition costs ____
- Implementation costs ____
- Operating costs ____

X. PLANNING FOR IMPLEMENTATION

X. PLANNING FOR IMPLEMENTATION

When the decision has been reached regarding the final system design, there remain the practical steps of implementing the system and preparing for the evaluation of the results achieved.

An important aspect of the implementation plan is the immediate designation of a program director who will proceed with the development of an implementation plan as soon as the budgeting authority is approved. The program director should be, for example:

- Acceptable to the user agencies
- Experienced in law enforcement or public safety planning
- Experienced in intergovernmental relationships
- Familiar with land mobile radio systems and telecommunications systems
- Familiar with governmental purchasing procedures and policies
- Willing to accept responsibility and delegate authority
- Experienced in financial and management controls
- Capable of negotiating with all levels of local and state government agencies.

The implementation plan should accomplish three major purposes:

- The complete definition of the work to be accomplished, subdivided into all the supporting tasks
- The time-dependent scheduling of all tasks to ensure that progress toward project achievement can be measured at all times
- The assignment of management responsibility with authority over the resources needed to accomplish all the tasks.

In the following paragraphs proposed levels of solutions commensurate with project size are discussed. Staff size depends upon program size. For small programs, all of the suggested procedures in this chapter can be accomplished by one properly selected program director.

1. WORK BREAKDOWN STRUCTURE

The work breakdown structure identifies all work that must be accomplished to complete the project. It is the foundation of the program director's planning and control system and should be formally documented even for small projects where a work breakdown structure appears to be obvious.

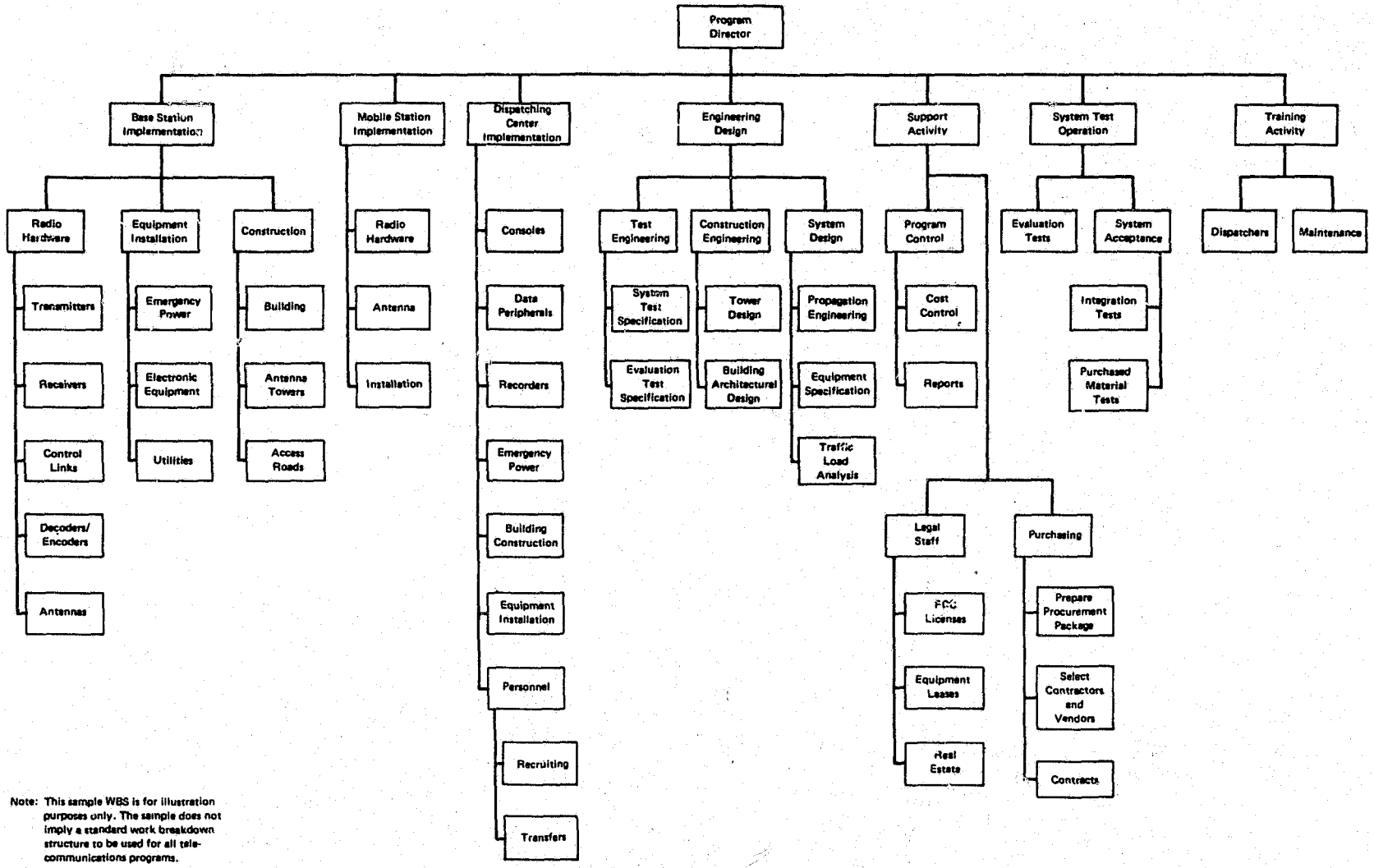
The basic organization of the work breakdown structure should be consistent with the management and budgetary structure planned for the telecommunications system. The breakdown of system hardware and software subsystems should continue until the desired level of control and performance responsibility is reached. A sample of a work breakdown structure is shown in Figure 6. The program is first broken down into its major program subdivisions; these in turn are broken down into their major components, and the components are broken down into the tasks needed to complete each component. This hierarchical breakdown continues until individual self-achievable work packages of manageable size are identified.

The diagrammatic method is valuable in planning the project because it shows interdependence and provides early indications of time relationships.

The following paragraphs address suggested considerations in developing a work breakdown structure. It should be clearly understood that the complexity of the project and the organization of the planning agency can significantly modify this list and the resulting work breakdown. The decision regarding the assignment of system integration engineering responsibility should be made before the work breakdown structure is developed. Some of the factors affecting that decision are shown in Table 16.

In the project illustrated in Figure 6, the total program, including management support, that is under the program director's responsibility is divided into seven major subdivisions. In the sample program, in-house engineering will have system integration responsibility. The major subdivisions are as follows:

- *Engineering Design* – Responsible for all design, development, system integration, technical analysis, and engineering. The supporting engineering tasks shown in Table 17 are also included in this responsibility.



Note: This sample WBS is for illustration purposes only. The sample does not imply a standard work breakdown structure to be used for all telecommunications programs.

FIGURE 6
Work Breakdown Structure

Table 16
System Design Engineering Responsibility

Responsible Agency	Considerations
Prime Contractor With Turnkey Contract	• Prime contractor has sole responsibility for system performance, including all subsystem interfaces and components • System cost is fixed by contract • User may have only token control over quality and price of system components
System Integration Contractor	• Subsystems and components purchased by user agency • Contractor is responsible for specifying interface between subsystems and components • Contractor shares responsibility for system performance • User agency is responsible for quality and performance of purchased materials • Possible cost escalation due to system changes
User Agency In-house Engineer	• Complete control over quality and performance of the system • Opportunity to provide system engineering at lower costs • In-house engineering must be specialized in telecommunications systems technology • Broad range of professional skills needed for system implementation must be totally contained within the agency staff

Table 17
Supporting Engineering Tasks

Task	Subdivision	Activity
Procurement Specifications Preparation	System Design	Prepare performance and purchase specifications for hardware procurement package
Test Specifications Preparation	Test Engineering	Prepare installation test specifications; subsystem acceptance test specifications, and system acceptance test specifications
Radio Propagation Engineering	System Design	Prepare engineering and support documentation for FCC license applications
Structural Engineering	Construction Engineering	Prepare specifications for antenna towers and tower foundations
Architectural Engineering	Construction Engineering	Prepare architectural design and specifications for new building construction Prepare the design and specifications for building renovation
Support Engineering	Engineering Design	Technical review of bid package documentation Technical review of bidder's technical proposals Technical review of training course material for dispatchers and maintenance personnel

- *Support Activity* – Responsible for program management functions and all business or legal activities related to the program. To neglect these management tasks in the work breakdown is to invite the neglect of project control functions.

- *System Test Operation* – Responsible for the conduct of all system and evaluation tests but not the test specification. An important function is that of testing purchased material.

- *Training Activity* – Responsible for the design and conduct of all personnel training programs.

- *Dispatch Center Implementation* – Responsible for determining the functional requirements, human engineering requirements, and facility requirements for the dispatch center. Preparation of the facility, installation of the hardware, and development of operation procedures are included.

- *Base Station Implementation* – Responsible for facility preparation and the integration of all hardware on a schedule compatible with normal operations.

Each major subsystem is broken down to the individual self-achievable task level shown in Figure 6. For example, a work breakdown under the support activity subsystem through the purchasing function will be illustrated.

- *Purchasing* – Responsible for all functions of the designated purchasing authority as legally defined.

  - *Procurement Package Task* – The preparation of a procurement package and the procurement documentation

  - *Select Contractor and Vendors* – The obligation to conduct a fair and equitable proposal evaluation and award

  - *Contract* – The task of negotiating and contracting for goods and services.

A complete work breakdown structure that includes all the indicated tasks and all other tasks unique to the specific program being planned is fundamental to all program control methods.

2. SCHEDULING

Effective management means scheduling realistically, identifying unresolvable delays when they occur or are imminent, and rescheduling related events around these delays to minimize overall program impact.

Time-dependent charts should be developed. The charts should show each task identified by the work breakdown structure and show the scheduled start date and completion date with intermediate milestone points to help monitor progress. The complexity of the project should determine the type of charts to be used in scheduling and control. Some basic forms are shown in Figure 7 and discussed in the following paragraphs.

(1) Gantt Charts

The traditional and basic method of showing time-related tasks is the Gantt chart technique.

The tasks shown on the Gantt chart are taken from the work breakdown structure. The start and end dates of each task are shown and the time-related relationship of all the tasks is clearly indicated. The Gantt chart is most appropriate for projects of modest scope where the interrelationships of the tasks are straightforward. The shortcomings of the Gantt chart for more complex programs are its inability to show the interdependence of the tasks and to show clearly the measurable points within the task needed for progress control.

(2) Milestone Charts

Milestone planning and reporting is one of the most widely used and universally accepted forms of management control. The primary advantage of the milestone technique is that it can be applied to any type of effort. It offers ease of implementation, simplicity of presentation and communication.

The tasks shown on milestone charts are taken from the work breakdown structure. The start and end dates of each task are shown and milestone points are added within the time frame of each task. Milestones represent clearly definable point-in-time accomplishments that are significant to the completion of the task and the program. The relationship of a milestone chart to a Gantt chart is shown in Figure 7. The shortcoming of the milestone chart is its inability to show clearly the interdependence of the tasks and milestones. Milestone charts can be developed for both time and cost control.

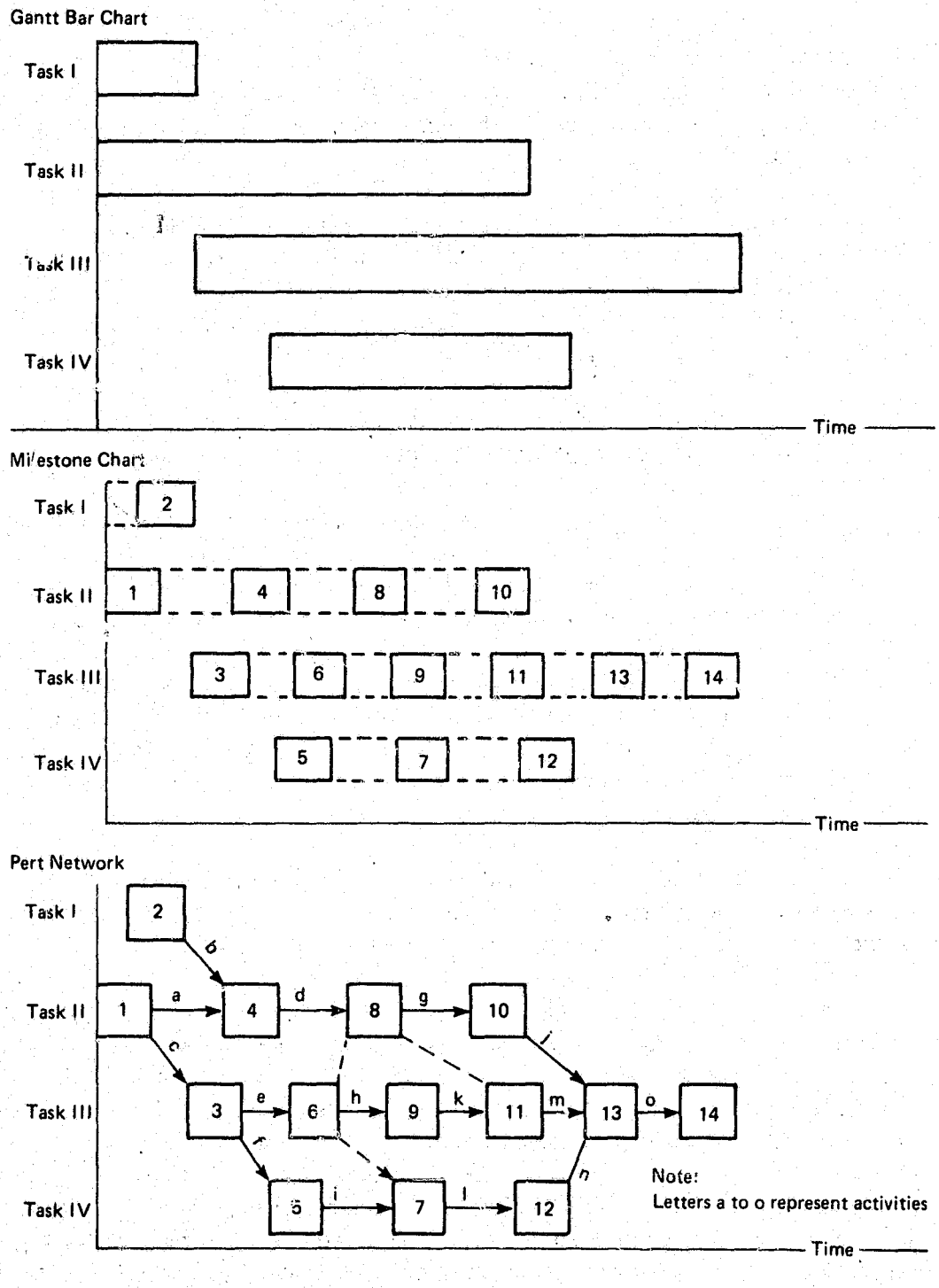


FIGURE 7
Transition from Gantt Chart to Pert Network

(3) Network Charts

Network techniques used for planning and control are particularly suited to complex programs involving numerous interdependent tasks. Perhaps the greatest value of network techniques lies in the enforcement of network logic during the planning process.

The most commonly recognized network methods are CPM (Critical Path Method) and PERT (Program Evaluation and Review Technique). Although developed independently, these techniques are similar. CPM highlights activities and PERT stresses the events that initiate or complete activities. The PERT technique is briefly described below.

The PERT network is a graphic presentation of the implementation plan and has two basic components: events and activities.

- *Event* – An "event" is defined as an achievement that can be clearly recognized and delineated at a point in time. It is depicted in the network as a circle. A number appearing in the event circle indicates the time sequence of events and facilitates computerization of the network.

- *Activity* – An "activity" is the work that is required to achieve an event. It is depicted in the network by a line or arrow connecting two events. The length of the activity line bears no relation to the time required of the activity it represents. These times are written as numbers above the activity line.

A simplified PERT network that illustrates the basic principles is shown in Figure 8. The logic and the rules for preparing a PERT network are rigorous and one of the many texts on the technique should be consulted (Refs. 28, 29).

The events shown on PERT networks are developed by analysis of the work packages that appear on the work breakdown structure. Once a detailed network has been developed, it may be desirable to consider its analysis (e.g., determination of the critical path) on a computer. The point at which computerization can be effective is for a network that exceeds 100 events.*

The relationship between PERT events and milestones is shown in Figure 7. The significant point in all program scheduling methods is the logic and thoroughness of the work breakdown structure. Its significance cannot be overemphasized.

*PERT network computer programs are usually available for most of the larger computer systems. The specialized services of a computer systems engineer should be consulted for the particular computer system application of PERT.

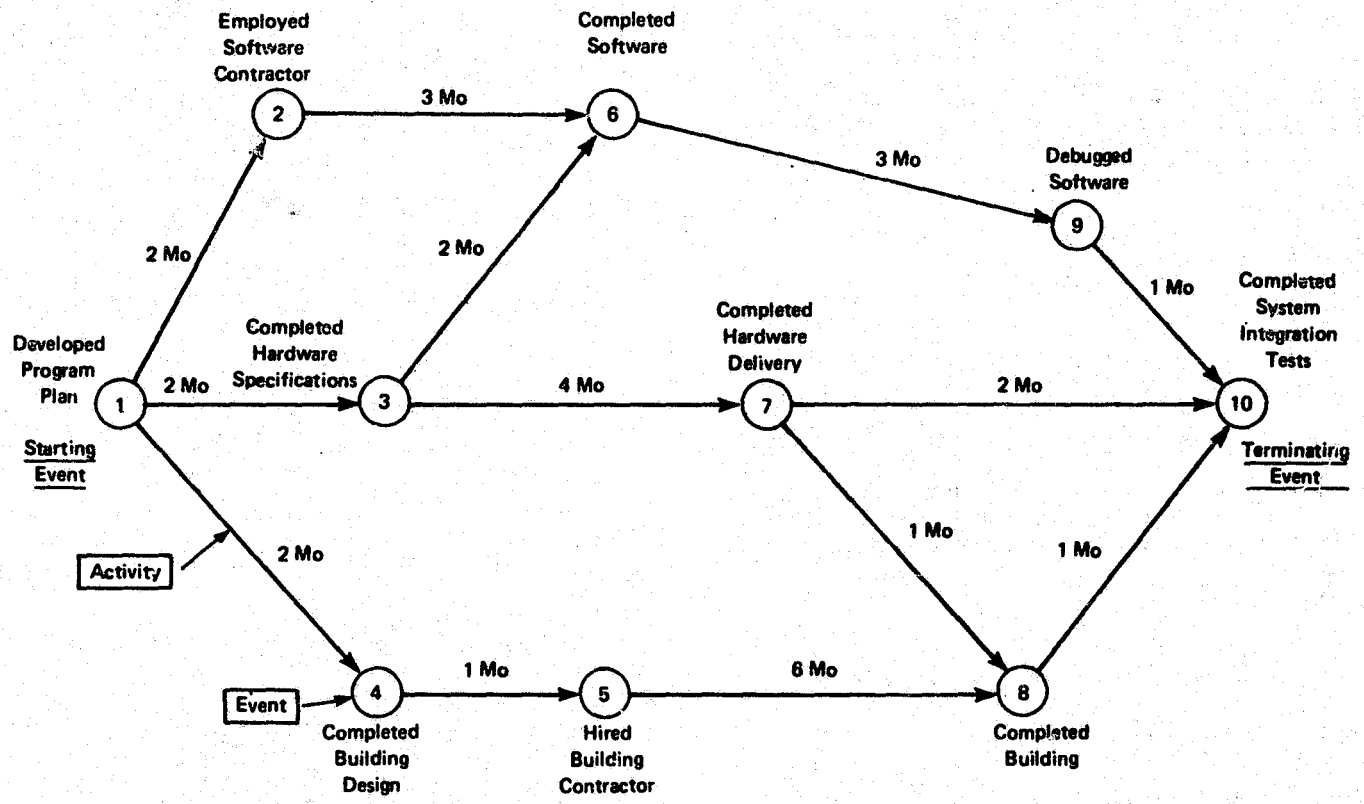


FIGURE 8
Sample Pert Network

3. MANAGEMENT RESPONSIBILITY

The implementation plan should define the project coordination structure and the responsibilities for management and control at each level and each task.

(1) Organization

The program director should be designated at once and given the authority and responsibility to implement the program within the time and funding constraints imposed. Some suggested characteristics of a telecommunications program director are listed on the first page of this chapter. The program director will develop the work breakdown structure and from this assign responsibility to complete each task.

For the implementation of a law enforcement telecommunications system, it is likely that task responsibilities will fall on members of several user organizations with responsibility to report back functionally to the program director. In an organization of this type it is of extreme importance that the responsibilities and authority of each member be clearly understood; formal notification is advisable. Tasks and responsibilities are negotiated to ensure a personal commitment to their timely accomplishment.

The program director's staff will consist of those persons responsible for major program subdivisions as defined by the top line of the work breakdown structure. This staff should provide the coordination of schedule changes and modifications.

(2) Reporting and Control

Reporting and control systems, based on the schedules established for completing the tasks, are needed for program coordination visibility. The reporting system should be as simple as the schedule of the system to which it relates will allow. Program task reports must be scheduled in advance of critical events with sufficient time to take corrective action, if necessary, to ensure on-time accomplishment. Reporting elements are:

- Time needed to complete the tasks
- Resources required to complete the tasks.

The reporting and control system should measure actual time and actual costs against scheduled time and estimated costs. In Figure 9 several systems of schedules and reports are suggested for different size programs.

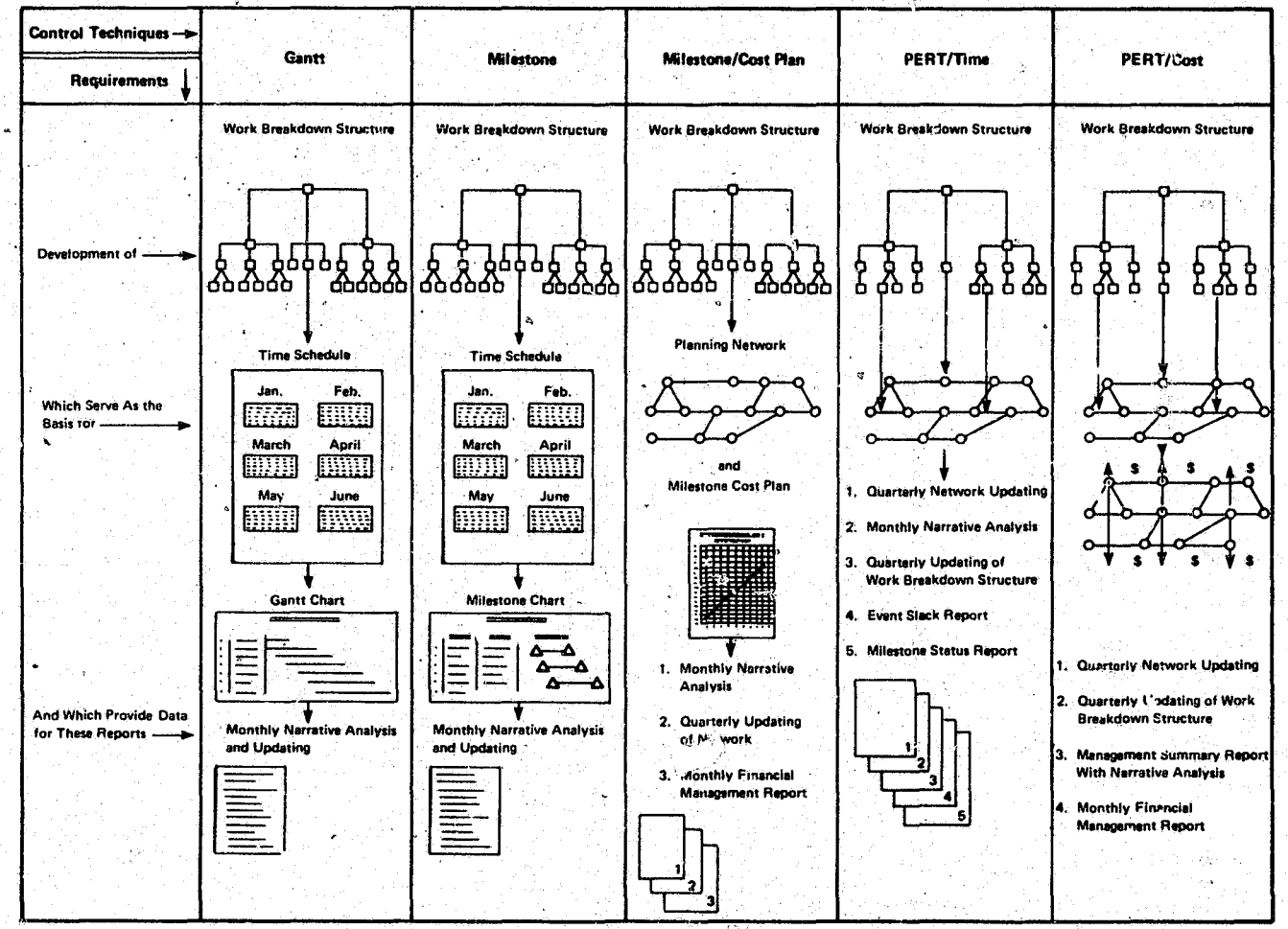


FIGURE 9

Pictorial Diagram - Management Reporting and Control Systems

The overall status report of the program is a simplification of the program task reports. Graphic presentations are useful for clarification. Figure 10 is a sample of a simplified milestone/cost presentation, and Figure 11 suggests graphical methods of reporting time and cost variations.

Costs can be related to tasks by assigning account numbers to each task, milestone, and event on the work breakdown schedule. The cost of the work completed is calculated from the charge numbers in these accounts, and compared directly with the time schedule of events.

4. DEFINE EVALUATION PROCEDURES

The criteria for evaluating the program should be generated in the planning stage when the goals, objectives, requirements, and priorities are being established. The responsibility for developing the evaluation procedures and conducting the system evaluation to these criteria should be assigned and scheduled as well as the other project tasks in the work breakdown structure.

Data needed for system evaluation should be acquired during the conduct of system and subsystem tests. The evaluation test procedures shoud be integrated with the system tests as these tests are being conducted.

Much of the evaluation will be scheduled after the system has been implemented. For example, the reduction in patrol response time can be determined only over a period of time after the communications system has been activated in full capability.

The implementation plan will have included the development of procurement specifications as an element of the plan. Chapter XI will address these procurement specifications and suggest the scope of their contents.

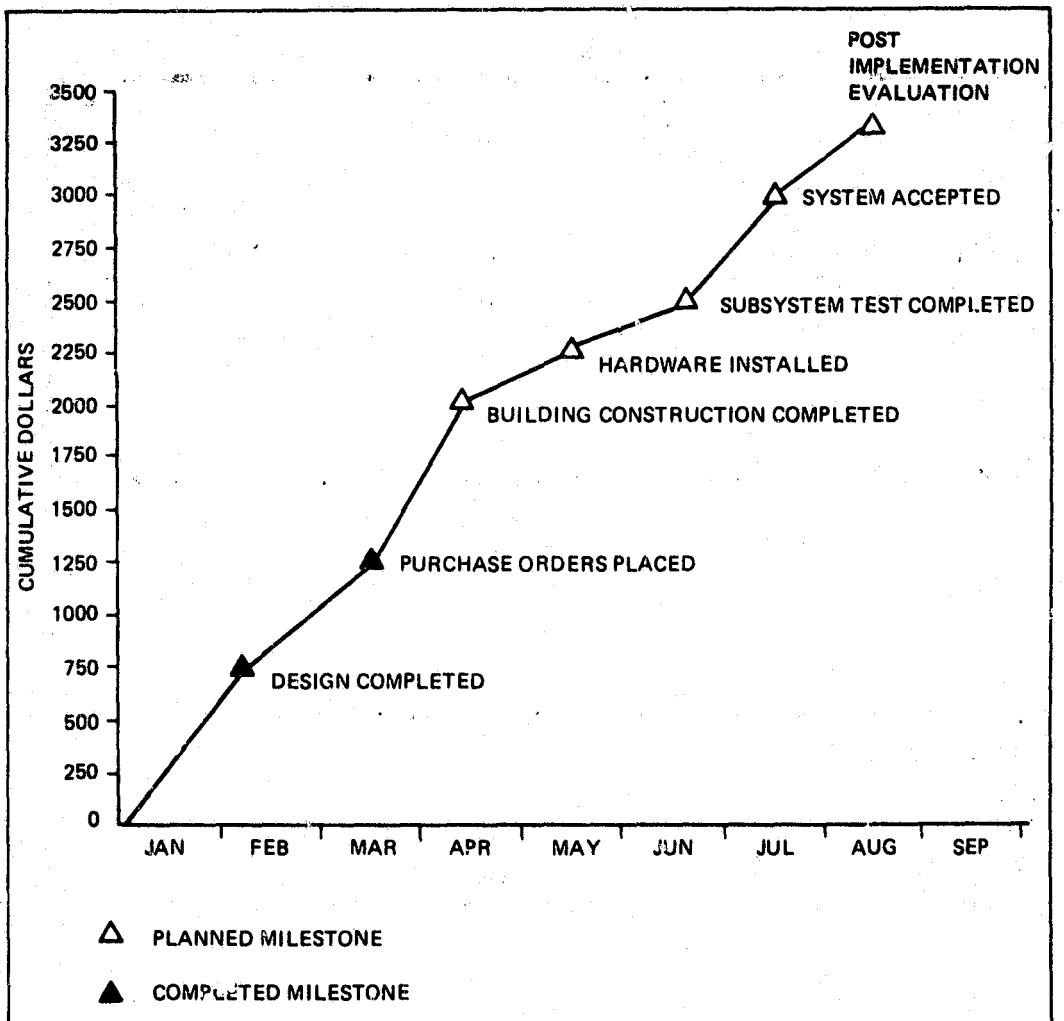
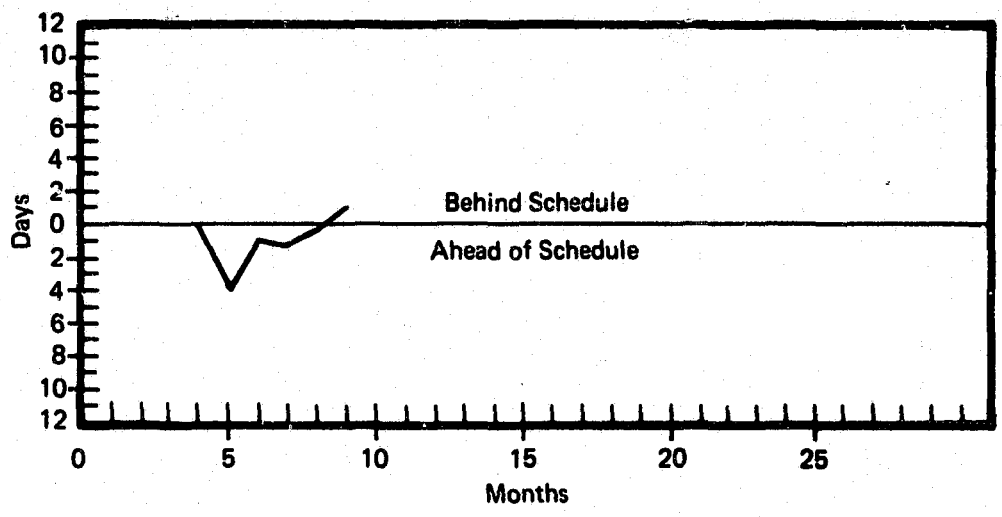


FIGURE 10
Sample Format for Graphic Milestone and Cost Plan



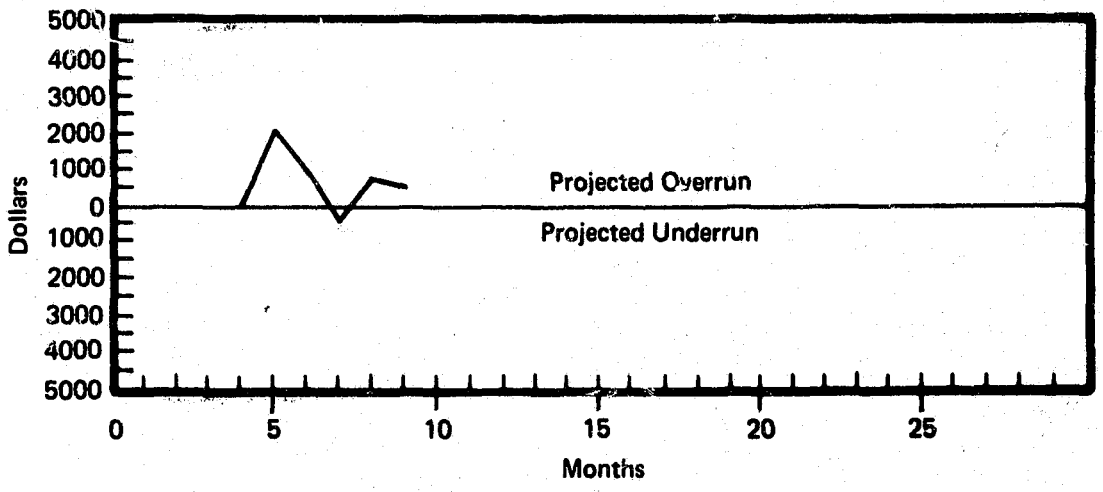


FIGURE 11
Example of Schedule Outlook Reports

CHECKLIST

X. PLANNING FOR IMPLEMENTATION

1. Has a program director been assigned? ☐

2. Has a work breakdown structure been developed? ☐

   Has the technical design function been identified? ___

   Has the program management function been identified? ___

   Has the purchasing function been identified? ___

   Are testing and evaluation functions identified? ___

3. Has a program schedule been documented and approved? ☐

   Is the project progress schedule complete? ___

   Is the project cost schedule complete? ___

4. Has the program management structure been established and documented? ☐

   Have authority and responsibility been defined? ___

   Have reporting and control functions been established? ___

5. Have project evaluation procedures been established, documented and implemented? ☐

CONTINUED

2 OF 4

XI. DEVELOPING PROCUREMENT SPECIFICATIONS

XI. DEVELOPING PROCUREMENT SPECIFICATIONS

The procurement specification describes the system, equipment, and services to be provided by the contractor or vendor. When made part of the contract with the successful offeror, it becomes the legal definition of what is to be provided under that contract.

Suppliers of equipment for conventional base and mobile radio systems stock units in several categories of quality from which the procuring agency can usually select needed equipment for its system. The equipment can be ordered with a variety of optional features. This equipment includes base, mobile, and portable radios with associated antennas, cabling, tape recorders and the like, and the simpler consoles for remote control of smaller base stations. Multiple-channel control consoles are available either as standard modular units or as custom-designed units. The procurement of standard catalog equipment has these advantages:

- Operational use over a period of years has resulted in correction of most design defects.
- Capabilities and limitations of the equipment become well known and usually are observable at a nearby jurisdiction.
- The cost is less and delivery faster than for custom equipment.

In view of these considerations, this chapter addresses the development of procurement specifications for telecommunications systems that use currently available stock equipment. Specific values for equipment characteristics will not be included, however, since these change from one situation to another and from year to year as capabilities of standard equipment improve. A useful approach is to make use of the guidance offered by Electronics Industries Association (EIA)* standards wherever appropriate in the development of equipment and system specifications.

1. PREPARATION OF SPECIFICATIONS

In several states a qualified state agency will prepare a series of equipment specifications that establish the quality and optional operating features of equipments normally stocked as standard items by national distributors. The suppliers are invited to submit

*Electronic Industries Association, Engineering Department, 2001 Eye Street, Washington, D.C. 20006.

competitive price bids based on an annual volume for each equipment specified. Usually, procurement through such state contracts provides cost and quality advantages for the small agency. The specifications and state contracts should include provisions for spare parts. Variations of this approach include the preparation by a qualified state agency of the basic specifications, leaving unspecified the optional features and the price of these options.

In some states, a state agency will contract with a consultant to perform design assistance and prepare specifications for local agencies. This aid may also include system test assistance. However obtained, such assistance never relieves the procuring agency of its ultimate responsibility for a procurement that fits its needs and is consistent with state and local procurement policies and regulations. Particular care should be taken in the use of trade names of equipments and optional features offered by only one vendor. System functions that exclude all except one vendor's equipment may not be the most cost-effective approach to the system needs and should be reexamined.

2. ELEMENTS OF A SPECIFICATION

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

(1) Introduction

The introduction should specify standards of quality applicable to all the equipment, such as the EIA standards for performance, without significant degradation when subjected to the applicable temperature, shock, humidity, and vibration tests of these standards (Ref. 30). It should be specified here that all equipment provided must be new. Other pertinent items that may be incorporated include:

- Identity of the purchasing agency and the user agency
- Intended use of the equipment or services
- Identity of applicable specifications such as the EIA standards, FCC type approvals, Underwriters Laboratory (UL) approval, and other state or local approved specifications
- Where appropriate, compliance with other FCC Rules and Regulations

- A statement of the order of dominance of the several specifications applied to the procurement
- A statement regarding the quality level of the equipment to be supplied
- A statement assuring the delivery of newly manufactured equipment
- Supplier's responsibility for interface compatibility with contiguous equipment and systems
- Supplier's responsibility for installation and checkout
- Supplier's responsibility for installation licenses or permits
- Methods and responsibility for verification of quality and performance parameters.

If the specification is derived from a parent specification, that specification should be incorporated by reference in the introduction. Statements regarding the intended use and functional design should include whether the procured equipment is new or is intended to replace or modify an existing system. If the procurement consists of a complete system, the intended method of operating the new system can be set forth here, delineating in detail the functions to be performed by the system.

(2) System Performance Parameters

System performance parameters consistent with the system functions specified are contained in the second section of this specification.

(3) Equipment Performance Parameters

For maximum clarity, performance and engineering design features for each equipment should be included under the generic name of each equipment type to be specified. Refer to Table 13 and Table 14 for suggested items to be specified.

(4) Computerized System Specifications

The preparation of specifications for automated computerized switching and storage systems requires technical expertise which should be obtained from external

specialized sources by the procuring agency if not available within the agency. The combination of automated hardware and compatible software is the province of the computer system designer. Computer hardware suppliers or software firms may be experienced in the public safety field and be able to develop an adequate computer system design. However, an independent system design contractor, specialized in the computer field, will often prove to be the better approach to the preparation of the specifications.

(5) Facilities Specifications

When buildings are to be erected or modified, the services of a licensed architect and engineer should be obtained for the preparation of any building plans, drawings, and specifications. Construction and erection contracts should be negotiated separately from the electronic hardware and software contracts, due to significant differences in contracting methods and procedures. The services of an architect will protect against violations in building codes, zoning restrictions, and damage that might arise from faulty modifications to the structural integrity of existing buildings. This professional service will also provide architectural integrity with the surrounding environment and can include considerations to withstand natural disasters.

(6) Interface Specifications

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

(7) Training Specifications

When a change of equipment is involved, the need for the training of operating and maintenance personnel should be considered. Training courses in operation and maintenance can be contracted for as a part of the hardware procurement. Training materials should also be procured under the contract in order to meet future retraining needs.

(8) Documentation Specifications

The procurement specifications should contain provisions for delivery of adequate manuals and documents needed to support the system and equipment during its operational life. Documentation should include equipment manuals containing operating instructions, theory of operation, schematic diagrams, wiring diagrams, and parts lists. It should also include diagrams of interconnections between equipments. These diagrams will be unique for each installation and, although they are needed for installation and maintenance, delivery to the user will often add to the cost of the system.

(9) Test and Acceptance Specifications

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

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

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

Base and mobile tests of radio coverage should not be undertaken until newly installed base and mobile equipment have been checked thoroughly for normal operation, including verification that the antenna, transmission line, and radio transmitter and/or receiver are properly matched. Appropriate notification of any over-the-air testing as required by the FCC Rules and Regulations should be made at least 10 days prior to the tests (Ref. 31).

The most significant acceptance test of a base and mobile system is verification that base and mobile communications are adequate to the intended minimum limits of coverage with no unintentional interference with other agencies on the same or adjacent channels. These conditions must be specified system parameters in order to be part of a systems acceptance test procedure.

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

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

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

The procurement methods and procedures that make use of the procurement specifications are discussed in Chapter XII.

CHECKLIST

XI. DEVELOPING PROCUREMENT SPECIFICATIONS

1. Are state level purchasing contracts available for the procurement of equipments? ☐

2. Do state or local agencies who traditionally buy telecommunications equipment have standard specifications available? ☐

   State Division of Telecommunications? ____

   State Police or Highway Patrol? ____

   State Highway Department? ____

   Large municipal police agencies? ____

3. Is a source of assistance available for the preparation of equipment procurement specifications? ☐

   From other state agencies? ____

   From outside contractor? ____

   From vendors and suppliers? ____

   From planning agency staff? ____

4. Have all elements been included in the specification document? ☐

   Is the introduction to the procurement needs complete? ____

   Are system and equipment performance parameters complete? ____

   Are specialized specifications for computer subsystems complete? ____

   Are facility needs specifications complete? ____

   Are system interface specifications complete? ____

   Are training specifications complete? ____

   Are documentation and manuals specific? ____

   Are test and acceptance specifications complete? ____

XII. PROCURING THE SYSTEM

XII. PROCURING THE SYSTEM

Before taking any procurement action that involves the expenditure of public funds, the planner and the procuring agency are obligated to comply with applicable state and local laws and regulations relative to obtaining goods and services. Federal laws, rules, and regulations will apply to procurements that involve the use of Federal grant funds and it is appropriate to determine from these documents (Ref. 32) the more stringent standards and procedures.

The following paragraphs provide guidelines for the basic procurement requirements and these may be modified by Federal, state, and local procedures. Legal counsel should be obtained during the preparation of the procurement documentation and the execution of the procurement policies.

1. METHODS OF PROCUREMENT

In general, the implementation of a law enforcement telecommunications system will require the purchase of standard goods and services that are readily available in a competitive environment. The basic tenet of procurement law is that all transactions, without regard to dollar value, shall be conducted in a manner to provide open and free competition (Ref. 32). This implies that most procurements will require the submission and evaluation of competitive bids based on well defined procurement specifications and procedures previously agreed upon and published.*

Another approved method of procurement is that of negotiation for goods or services where competitive pressures alone do not exert sufficient influence to guarantee price or delivery. This method of procurement is not intended to preclude competition but can be employed where the scope and complexity of the procurement requires greater flexibility than is possible under a publicly advertised procurement. The rigidity of the procurement requirement in cases of unique or specialized services may reduce the market to only one offeror. Same standard methods of procurement are briefly described as follows:

*Throughout this document the word "bid" will mean the submission of a firm dollar offer to provide goods or services previously defined in a publicly advertised notice.

(1) Invitation for Bid (IFB)

This fundamental procurement medium, often called an Invitation for Bid (IFB), is used where goods and services to be purchased are standardized to the degree that clear and accurate descriptions and specifications can be publicly advertised. These will be completely understood by the buyer, the public, and the supplier with price alone being the decisive variable.

This procurement method is characterized by open public advertising, sealed bids, and a public bid opening. The procurement usually results in a firm fixed-price contract.

(2) Requests for Proposals (RFP)

This often-used procurement method has great utility where the system operational requirements are well defined, but the study of system alternatives has shown that more than one combination of electronic system hardware and software will provide an acceptable solution. The Request for Proposal is an invitation to qualified systems and hardware suppliers to propose their most cost-effective solution to the system performance requirements. Cost proposals are usually submitted for each solution.

This type of procurement is also useful in the purchase of engineering services to perform the system design in preparation for an RFP. Highly specialized systems engineering consultants will usually make their services available through this competitive procuring medium. These applications of RFP procedures will be discussed in more detail in later sections of this chapter.

This procurement method is characterized by selective advertising through "bidders" lists, sealed proposals, and carefully structured proposal evaluation criteria in which price is but one evaluation element. Contracts are usually negotiated and may take any of the legally acceptable contract forms.

(3) Noncompetitive Procurements

This negotiated procurement method is a legally valid procedure only if in accordance with the laws governing the procuring agency and available from only one person or firm. This condition can exist in the following ways:

- The skill of a known specialist may be required to perform a unique technical service

- The manufacturer of the existing electronic system may be needed to update the equipment to his latest configuration
- The effort may be a continuation of an ongoing contract or an addition to contract work previously completed by the proposed contractor
- Competition may be precluded by patent rights, copyrights, or secret processes
- Competition may be precluded due to an emergency situation or severe time constraints.

Small purchases are frequently procured by means of purchase orders. Purchase orders are normally used for stock items having established prices and therefore are not negotiated.

In almost all cases where the procurement exceeds a nominal fixed dollar amount, regulations will require prior justification and written approval before entering into a contract arrangement. The planner should consult appropriate regulations and guidelines (Ref. 33).

2. ASSEMBLY AND DISTRIBUTION OF THE PROCUREMENT PACKAGE

For maximum open and free competition, the goods and services being purchased should be clearly and accurately described so that all offerors may quote under the same terms and conditions. Some fundamental requirements are suggested below and discussed in more detail in the following paragraphs.

- The needs of the procurements should be defined in comprehensive and explicit terms
- Specifications should not limit the procurement to one supplier's equipment or services
- Delivery cycles should be attainable by more than one supplier
- The terms and conditions should not make the procurement exclusive due to unreasonable constraints
- Proposal evaluation criteria should be clearly defined and should avoid ambiguity.

(1) Purchasing Authority

The identity of the person specifically authorized to negotiate and adminster contracts should be clearly indicated. Where only one agency or community is involved, this person should be the local government employee normally possessing that authority. When pooled or centralized procurement results in a single point of purchase for several political entities, as it would for a regionalized telecommunications system concept, formal concurrence of the participants will be required. The agreements should include the identity of the one person authorized to commit all participants to procurement contracts.

Throughout this guide "purchasing agent" will be used as the generic title of the person possessing the authority to commit to contracts.

(2) Standard Procurement Package Clauses

Standard procurement package clauses vary significantly throughout the public safety domain. The purchasing agent for each procurement region will define the exact number and form of the standard clauses required by law, ordinance, or regulation. These purchasing procedures together with the standard clause for each type of procurement should be part of the data base of each planning agency. Table 18 suggests items of a checklist for basic clauses.

(3) Procurement Package Contents

The procurement package is intended to provide all prospective offerors with information needed to prepare proposals that are complete and responsive. A list of suggested items that are applicable to a wide variety of procurements in the field of telecommunications is shown in Table 19.

(4) Procurement Advertising

The purchasing agent should advise the planner if public advertising is required by law or regulation. The planner will coordinate these requirements with the purchasing agent. In all Invitations for Bid (or Quotation) where price is an adequate basis for award, publicly advertised procurements should be required. For negotiated procurements, advertising in the local media and in the trade press assists in the development of an acceptable "bidders" list.

Table 18
Suggested Standard Procurement Package Clauses (Ref. 34)

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 commiting 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
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

Table 19
Suggested Procurement Package Items

Title	Brief Description
Purpose	A brief statement of the reason for the procurement
Background	A brief recitation of factors leading to the procurement
Objective	What is expected to be gained by the procurement
Scope of Work	A complete work statement breakdown by task and hardware item in clear language
Specifications	Detailed hardware, software, and system performance specifications, including environmental limits and test requirements*
Delivery	Detailed deliverable items and date, time, and place of delivery, detail includes points of inspection and criteria for acceptance
Reports	Progress reports and final report requirements
Type of Contract	The type of contract expected from the procurement
Financial Schedule	The total value of the procurement, schedule of payments, and other financial guidance detail
Descriptive Proposal	Instructions relative to the acceptable outline and contents of the narrative proposal that describe the equipment and services being offered
Cost Proposal	The form and content of the offeror's cost breakdown
Facilities Proposal	The detail of specific facilities and specific personnel to be used in meeting the contract commitments
Authorized Persons	Identify of the persons authorized to negotiate and sign contracts
Procuring Officer	Identity of the person authorized by the purchaser to answer offerors questions prior to bid closing
Due Date	The time and place the proposals or bids are due, the requirement for the offerors to guarantee the cost proposal for 90 days or more
Proposal Evaluation	A clear and concise statement of proposal evaluation criteria
Negotiation	Provisions for oral presentations and negotiation on terms, conditions, price, and delivery

*See Chapter VIII for discussion of procurement specifications.

The procurement advertising should be as inclusive of the detailed requirements and limitations of the procurement as possible. For a Request for Quotation or an Invitation to Bid type of procurement, the advertisement alone should be sufficient for a responsive bid. For Request for Proposal type of procurement, a full procurement package is normally required in addition to the advertisement to enable an offeror to prepare a responsive proposal.

For negotiated procurements, selective solicitation by letter to known suppliers on "bidders" lists developed by the procuring agency or agencies that have previously solicited telecommunications system proposals can be an effective method of advertising. This should be supplemented by public advertising to bring newly qualified competitors into the solicitation.

"Bidders" lists are useful mailing lists of suppliers who are known to be responsive to procurement invitations in certain selective fields of interest. Removal of a supplier's name for cause from such a list, once it has been formally established, can imply serious legal consequences. As a result many lists are informal but are helpful in assuring that the majority of competitors are invited to participate in a procurement at approximately the same time. Suppliers are usually added to the lists or removed from the lists at their own request.

(5) Procurement Scheduling

Procurement scheduling, from the time the procurement package is assembled to the time a contract is signed, must be included in the planner's milestone charts as procurement lead time. Some of the sequential factors making up procurement schedule time estimates are shown in Table 20.

These factors apply in varying degrees to all competitive procurements. It is the planner's judgment as to the degree of importance and time to be assigned to each factor.

3. CONDUCTING PREPROCUREMENT CONFERENCE

The preprocurement conference is used in competitive procurements where the quality of contract performance can vary among the suppliers according to their individual understanding of the problem. The conference is often used for RFP types of procurements. The purpose of the conference is to clarify questions raised by the potential suppliers and bring to light factors affecting the procurement that may have escaped the planner or purchasing agent in preparing the procurement package and specifications. The results of preprocurement conference discussions become part of the RFP.

Table 20
Procurement Schedule Time Factors

Time Factor	Time Schedule Considerations
Solicitation	Time for media advertising and potential offeror's response
Deliver Procurement Package	Time for mailing and delivery to prospective offerors
Briefing	Time to prepare and conduct a public meeting with prospective offerors
Specification Review	Time to modify the procurement package as a result of the briefing
Proposal Preparation	Time for offerors to prepare a responsive proposal
Proposal Evaluation	Time to evaluate all offeror's proposals
Oral Presentations	Time for oral reviews of the proposals from each acceptable offeror
Reevaluate Proposals	Time to reevaluate each acceptable proposal as a result of inputs from the oral presentations
Negotiate Contract Terms	Time needed to negotiate terms, conditions, delivery, and cost with one or more offerors
Execute Contract	Time needed to prepare and execute an acceptable contract document with the successful supplier

(1) Scheduling

The procurement package should be in the hands of all suppliers prior to the preprocurement conference to enable them to study the documentation and prepare reasonable questions. It is advisable to allow time for the submission of written questions before the time of the conference so that:

- The questions may be more meaningful and concise
- Technical research that may be necessary to respond to the question may be carried out
- Legal implications of the questions may be discussed with counsel

The place and time of the conference should be clearly defined in the procurement package.

(2) Procedure

The conference should be planned for absolute equal opportunity for all suppliers in attendance. The following factors should be considered:

- *Conference Chairman* – The conference should be presided over by the purchasing agent.
- *Schedule* – The purchasing agent should open the conference at the advertised starting time and close the meeting at the advertised closing time.

  Personnel – The purchasing agent should introduce by name and position all sponsoring personnel at the conference.

  Attendees – The purchasing agent should make a written record of the name, title, and company affiliation of all attendees.

  Written Questions – Written questions previously received from the potential suppliers should be read and answered. The identity of the supplier submitting the question need not be disclosed.

  Conference Questions – Each speaker should be identified by name, title, and company affiliation. The questions should be recorded accurately. If research is required by a question, the answer should be deferred.

Conference Report – All suppliers should be provided with any resulting procurement package modification or specification modifications in writing. A complete written list of all suppliers attending might also be provided.

4. PROPOSAL EVALUATION

Whatever criteria are selected to be the basis for evaluating proposals and making contract awards should be included in the procurement package with a clearly stated order of importance. Normally the criteria are divided into five main categories:

- Contractor's managerial ability
- Technical capability and approach in meeting specifications
- Reasonableness of the cost estimate
- Experience and reputation of the contractor
- Financial integrity of the contractor.

The cost estimate alone is seldom the ruling criterion in evaluating proposals or in making negotiated awards but it is usually the sole criteria for evaluating responsive bids for publicly advertised procurements. Except as noted, the following discussions regarding factors of evaluation refer only to proposal evaluations and not to advertised bid procurements.

The planner and the purchasing agent must plan the proposal evaluation procedures to ensure that all proposals are evaluated by the same method and by the same criteria. The proposal evaluation board should represent fairly the planning agency and the user agencies. In numbers the board should be as small as possible. The board members should represent the three principal interests: technical, managerial and financial. It is appropriate for the board to call upon outside specialists when the systems being evaluated are complex and the needed level of evaluation skills cannot be found in a few persons.

Suggested procedures to be considered in evaluating proposals are addressed in the following paragraphs.

(1) Due Date

Proposals submitted after the expiration of the due date and hour as delineated in the procurement package are invalidated. Proposals received after that time are rejected unopened without exception.

(2) Conformance to Procurement Package and Instructions

Proposals that violate the instructions regarding form and procedure prevent these proposals from being compared fairly item-by-item with conforming proposals. These offerings could be rejected at the discretion of the procuring agency.

Some of these factors that might prevent a fair comparison are shown in Table 21.

(3) Preliminary Evaluation of Proposals

Conforming proposals are first evaluated in broad general terms to identify the obviously deficient offerors. Factors that would cause rejection of otherwise conforming proposals could include:

- *Failure to Understand the Problem* – Obvious or gross misunderstanding of the problem as defined in the procurement package
- *Total Cost* – Gross underestimate or gross overestimate of cost as compared to the average costs delineated by all offerors
- *Personnel* – Proposed personnel with inadequate experience (can be interpreted as a failure to understand the problem).

(4) Evaluation of Conforming Proposals

Conforming and acceptable proposals should be compared and evaluated on an item-by-item basis. Numerical point scores should be established for each item of evaluation and accredited to each offeror's proposal. The number of points per item and the weighting factor assigned to each item must be publicized and known to all offerors and evaluators alike. This scoring system, once devised, must be impartially applied by all evaluators and to all proposals under consideration.

A proposal which offers an alternative that is in contrast to that specified in the RFP, or which takes exception to some of the specifications, should also be evaluated. The same evaluation criteria should be used. If an alternative proposal or a suggested change in specification appears in the best interest of the procuring agency, the planner and purchaser may consider requesting each offeror to modify his proposal; or depending upon the nature and scope of the change, could negotiate the change with the successful contractor, or with the leading contenders.

Table 21
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

Acceptable evaluation criteria should include the following questions for comparative point evaluation: (Ref. 32)

- *Understanding the Problem* – How well did the offeror interpret the problem? Was the background well articulated and were the alternative solutions well defined? 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)?

- *Offeror's Background* – Does the offeror specialize in the required field and does he have a good record of performance?

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

- *Cost* – Is the cost proposal compatible with the statement of work? What is the offeror's relative position in range of acceptable costs?

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

- *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?

- *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 procedure should continue until it clearly identifies a successful offeror. The successful offeror should be notified that the contract is in preparation and the date it is expected to be signed and implemented. All unsuccessful offerors should be notified.

5. PRECONTRACT AWARD NEGOTIATIONS

Following proposal evaluation one or more offerors may emerge as potential contractors. The successful offeror and the definitized contract will be determined by negotiation.

(1) Negotiation Objectives

The first objective of the negotiation is to identify the most favorable proposal, and the ultimate objective of the negotiation is to arrive at an agreement on a complete contract, including:

- Contract type
- Statement of work and attendant requirements
- Period of performance
- Identity of deliverable items
- Contract amount and fee or profit
- General terms and conditions
- Special terms and conditions.

(2) Memorandum of Negotiations

A memorandum of negotiations is next only to the contract itself in order of importance. A negotiation memorandum should be written in a narrative chronology to ensure the proper sequence of discussions and understandings.

The memorandum is a complete record of who participated, the date, the purpose of the negotiation, what was proposed, counterproposed, and agreed on. The memorandum will be included in the contract file.

6. POSTAWARD DEBRIEFING

Unsuccessful offerors may request postaward debriefings of their proposal. The reason for the debriefing is to enable the individual supplier to understand where and to what extent his proposal was weak and thereby unsuccessful. The intent is to make the supplier a better competitor on the next procurement. Conditions for conducting the debriefing should include:

- *Privacy* – Conduct the postaward debriefing with each supplier in private

- *Scope* – Debrief each supplier on his *own* proposal *only*. Make no comparisons between his proposal and any other proposal.

7. PROCUREMENT CANCELLATION

As a result of the proposal evaluation, information may have been developed to indicate that the procurement, as defined in the procurement package, should be canceled. This right to cancel the procurement has been retained in the Standard Clause section of the procurement package. Some of the factors that could lead to this conclusion include the following:

(1) Unacceptable Proposals

It is possible that in evaluating all proposals received as a result of an RFP and carefully grading these proposals in terms of acceptance criteria no proposal reaches the minimum level of acceptance.

(2) System Specifications

In proposing solutions to the problems defined in the procurement package, the offerors may have identified factors of system performance that significantly alter the tasks as defined in the original procurement package.

(3) Excessive Costs

It may be evident from the proposal evaluation that the equipment or services sought under the procurement cannot be acquired for the funds available. The circumstances of the procurement cancellation will determine whether or not a new procurement will be initiated.

8. NEGOTIATED SOLE-SOURCE AWARDS (Ref. 32)

Generally, sole-source procurements may be negotiated if the material or service to be procured is available from only one person or firm. In almost every case, legal tests for sole-source procurement must be satisfied and written approval obtained before any request for a sole-source procurement is made. The planner should consult recognized

legal authority at local or higher level for these instructions and for appropriate approvals. Reasons that would justify a sole-source procurement would include:

- Modification of existing proprietary equipment
- Manufacturer's updating of existing hardware at a fraction of new equipment costs
- Services of a recognized and uniquely qualified expert
- Extension of an existing and ongoing service contract
- The facilities or services needed are specialized, unique, and vital to the effort
- Competition is precluded because of the existence of patent rights, copyrights, secret processes, emergency conditions, or critical lack of time.

An additional procedure imposed by LEAA on the planner's request for approval of a sole-source negotiated contract is the declaration of a plan to avoid future noncompetitive procurements (Ref. 32). The action must include the examination of the reasons for the procurement being noncompetitive and the steps taken to foster a competitive environment for subsequent procurements.

Federal, state, and local procurement regulations will usually define dollar limits for individual contracts awarded on a noncompetitive basis. These regulations will also define the level of documented justification required of each procurement. The procedure will vary between approval agencies and between economic regions. The specific terms of approval should be determined for each contracting situation.

The procedures for preparing a sole-source Request for Proposal, the procurement package, and the evaluation of the proposal for sole-source contracts are the same as those required of a competitive negotiated procurement. In the absence of competitive pressure, particular attention should be paid to the preparation of a clear and concise Statement of Work and the evaluation of the resulting proposal. Negotiations should remove any ambiguity regarding deliverables, cost, schedules, and the measure of performance.

9. PREPARING CONTRACTS

The purchasing agent on each procurement entered into by the planner will usually have a standard form contract that has been tested in the courts and should be adhered to. These standard forms and the standard clauses that become part of these forms should

be included in the data base of the planner. The purchasing agent for the procurement will have the proper legal facilities for preparing the contract. The planner should provide the contract material that has been made available through the procurement package and the negotiated response from the successful bidder. A draft contract should be drawn up including these materials.

(1) Review of Draft Contract (Ref. 34)

It is necessary for the planner to review the draft contract in detail to be certain that it is inclusive of all items negotiated with the chosen contractor. In addition, the following provisions should be included in all contracts and subgrants:

- Disputes, appeals, and remedies
- Terminations
- Bonding for construction contracts
- Copeland "Anti-Kick Back" Act for construction contracts (Ref. 32)
- Equal employment opportunity
- Contract work hours and Safety Standards Act for construction contracts (Ref. 32)
- Patents, data, and copyrights
- Freedom of Information (Ref. 34)
- Compliance with economic stabilization programs
- Clean Air Act
- Small business and minority business provisions.

(2) Penalty Clauses

If the contractor's failure to perform under the provisions of the contract will result in a clearly defined monetary loss, provisions to recover these monetary damages may be included in the contract. Recovery of such damages is usually through judiciary process.

A penalty clause is a contractual encumbrance if its basis is punitive and is not supported by an auditable monetary loss. A penalty clause should be used with caution and only with advice of legal counsel.

(3) Type of Contract (Ref. 32)

The type of contract should be determined by the nature of the program. Some of the more common forms include the following:

- *Fixed-Price Contracts* – These contracts limit the price for the total effort undertaken; however, each allocates the element of risk and incentive in a different manner. The three forms are:

  - Firm Fixed-Price (FFP)
  - Fixed-Price with Escalation (labor and raw materials)
  - Fixed-Price Incentive (FPI)

- *Cost-Reimbursement Contracts* – These contracts are used when uncertainties are involved in contract performance or elements of cost. The common forms are:

  - Cost-Plus-Fixed-Fee (CPFF)
  - Cost-Plus-Incentive-Fee (CPIF)
  - Cost-Plus-Award-Fee (CPAF)

  The terms of these contracts usually include a target cost, target fee, or other means of limiting the maximum expenditure.

- *Time and Materials and Labor-Hour Contracts* – These contracts provide for the purchase of services on the basis of payments limited to labor performed and for materials at cost.

- *Indefinite Delivery Type Contracts* – These contracts are used when the time of delivery is not known at the time of contracting. This type of contract is usually used in telecommunications for pooled or centralized procurements. The following three forms are common:

  - *Definite Quantity Contract* – The quantity is known but the time of each partial delivery is not known.

- *Requirements Contract* – The quantity and schedule can only be estimated. Delivery will occur throughout the contract life but at the contract cost per unit.

- *Indefinite Quantity Contract* – The quantity is expressed in terms of agreed minimum and agreed maximum over the life of the contract.

(4) Schedule of Payments

The schedule of progress payments, the time of payments, amount of payments, and the conditions to be met before payment is authorized are negotiated items. These negotiations become the definitive contract payment terms.

The foregoing paragraphs have provided an overview of the factors to be considered in procuring the telecommunications system. The legal implications of procurement policies make this highly specialized task the province of specialists and the planner should seek experienced counsel.

CHECKLIST

XII. PROCURING THE SYSTEM

1. Have all applicable Federal, state and local laws or regulations regarding the procurement of goods and services been considered? ☐

2. Has the method of initiating the procurement been established and documented? ☐

   Invitation for Bid ____

   Request for Proposal ____

   Sole-source procurement ____

3. Has a complete procurement package been prepared and distributed to potential offerors? ☐

   Has procurement been properly advertised? ____

   Are all standard clauses in the package (Table 18)? ____

   Are all standard items in the package (Table 19)? ____

   Has the purchasing authority been named? ____

4. Is a preprocurement conference needed? ☐

5. Has adequate time been scheduled to allow offerors to prepare a fully responsive bid or proposal? ☐

6. Has the proposal and bid evaluation been conducted in a routine and well documented manner? ☐

   Was preadvertised evaluation criteria followed? ____

   Were only responsive bids evaluated? ____

7. Were the preaward procedures conducted according to procurement regulations and well documented? ☐

   Were precontract award negotiations conducted? ____

   Were unsuccessful offerors properly notified? ____

   If there was no award, was the cancellation of the procurement initiated? ____

8. Was the award made on a sole-source basis? ☐

   Was grant agency approval obtained? ____

   Were all procurement regulations followed? ____

   Was the offeror's proposal evaluated and the evaluation documented? ____

   Was the offeror's price and performance negotiated and documented? ____

9. Was the procurement contract prepared by a recognized legal procuring authority? ☐

   What was the type of contract negotiated? ____

   Are all procurement guidelines reflected in the contract? ____

   Are the deliverables clearly defined? ____

   Is the schedule of performance well defined? ____

   Is the schedule of payments clearly defined? ____

   Is punitive clause clearly auditable? ____

XIII. POSTIMPLEMENTATION EVALUATION

XIII. POSTIMPLEMENTATION EVALUATION

The postimplementation plan should relate directly to project goals and objectives as defined in Chapter IV. When project objectives are being defined, the related criteria for evaluating the achievement of these objectives should also be defined. The implementation plan should call for the accumulation of system evaluation data during acceptance tests and system performance tests. This data will assist in determining the basis for postimplementation evaluation measurement. The following paragraphs discuss fundamental elements of the evaluation effort.

1. SIGNIFICANCE OF PROJECT EVALUATION

Limited resources are available to local, State, and Federal governments to support a variety of law enforcement programs, which include the telecommunications system as one of the many elements of public safety and law enforcement. Competition for these financial and physical resources demands proof of beneficial performance from the planner and the implementing agency in terms of public safety improvement if continued support is to be offered.

Title I of the Omnibus Crime Control and Safe Streets Act of 1968, as amended by the Omnibus Crime Control Act of 1970 and the Crime Control Act of 1973 (P.L. 93-83), provides the basis for Federal grants-in-aid for law enforcement purposes. Under Part C of this law, project evaluation is obligatory on the state planning agency (Refs. 4, 15) that administers these grant funds. The objectives of the evaluation are threefold:

- 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.

2. EVALUATION PLAN

Evaluation planning begins with the initial preparation of the project plan. The plan should provide answers to the questions:

- Did the project accomplish what it was planned to accomplish?

- Did the project contribute to local and State law enforcement goals and objectives?

- What side effects, desirable and undesirable, can be ascertained from project operations?

The plan should result in an evaluation report that will meet the requirements set forth in the LEAA Guidelines Manual (Ref. 15).

(1) Evaluation Baseline

Evaluation is simplified if the project description contains clear and quantifiable statements of the expected results of the project. The definition of program objectives and requirements, as described in Chapter III, provided quantifiable evaluation criteria. Establishing these criteria should be a factor in initially setting the program objectives and requirements.

Law enforcement telecommunications projects themselves tend to assist in defining measurable evaluation parameters. For example, mutual aid communications between the sheriff and the police can be a program requirement. The attainment of this requirement is easily measured. In law enforcement telecommunications programs the evaluation criteria are often the obvious attainment of requirements such as these.

(2) Developing an Evaluation Plan

The evaluation plan is part of the program plan and is also part of the work breakdown structure. It shares management attention and resources together with the other program tasks. In preparing the plan and its work breakdown, the following elements should receive consideration: (Ref. 15)

- The desirability of relating the program evaluation to specific types of crime or law enforcement goals

- The assignment of responsibility for the administration of the evaluation program to a specialized task group

- The need to develop a staff or to secure consultants who can make use of current methodology such as criteria development, sampling techniques,

and control techniques, cost/benefit analysis, simulation modeling, and correlation analysis

- The relative use and need for an independent evaluation study in lieu of self-evaluation
- The documentation of evaluation alternatives
- The collection and use of statistics
- The use of evaluation results in program and budget development.

(3) Performance Evaluations

The responsibility for performing the evaluation will depend on the size and complexity of the telecommunications project. In general, any one of three levels of evaluation responsibility will conform to the guidelines criteria:

- Self-assessment in accordance with state planning agency guidelines
- Direct planning agency effort
- Contract assistance by evaluation specialists.

3. SCOPE OF EVALUATION

Evaluation should include all elements of program and project performance. Continued support by state and Federal governments will be strengthened by clear evidence of result-oriented planning at every level. Some of the elements to be included in the evaluation are outlined in the following paragraphs.

(1) System Effectiveness

- *System Organization* – Determine if the roles of individuals and organizations are reasonable and are being carried out properly.
- *System Use* – Determine if system inputs and outputs are used as intended in the plan. Identify system parameters that have modified system use subsequent to implementation.

- *System Performance* – Determine if the availability, reliability, and geographic coverage of all system telecommunications circuits have been adequately satisfied according to plan.

(2) Technical Evaluation

The intent of the evaluation is to determine how well the equipment specifications have been met. The considerations include the following:

- *Performance* – Determine how well each item of equipment meets the detailed procurement specification parameters.
- *Reliability* – Determine if an acceptable value of mean-time-between-failure is being attained.
- *Maintainability* – Determine if the provisions for ease of maintenance are adequate.
- *Operation* – Determine if the level of skill needed and the number of personnel needed are reasonable.
- *Service* – Determine if the equipment supplier has made provisions to support the warranty and replacement parts requirements.
- *Technology* – Determine if the delivered equipment includes the most effective technical improvements.
- *Compatibility* – Determine the level of compatibility with existing system components and components contemplated for future system growth.
- *Special Characteristics* – Determine if supplied equipment and software include effective and unique features not contemplated in the procurement specifications.

(3) Financial Evaluation

Projects and programs should be evaluated on the basis of worth and value. Some of the items of financial evaluation include the following:

- *Investment Costs* – Determine if the costs of procuring all goods and services show adequate cost-effectiveness.

- *Operating Costs* – Determine if the system operating costs provide maximum service at minimum recurring cost.

- *Cost Control* – Determine if accounting and cash flow procedures are in accord with acceptable audit standards.

- *Value Standards* – Determine if target values in terms of performance per dollar have been established and adequately satisfied.

- *Reports* – Determine if interior and exterior financial reports have been complete, timely, and accurate.

(4) Management Evaluation

The management of the program or project should be structured in accordance with the size and scope of the effort. The evaluation of management includes some of the following considerations:

- *Responsibility* – Determine the degree to which performance responsibility was defined, delegated, and carried out.

- *Organization* – Determine if the organization structure is the most cost-effective structure for the program complexity.

- *Skills* – Determine if the proper level of management, technical, financial, and other specialized skills are adequately employed in managing the program.

- *Interrelations* – Determine the adequacy of interrelations with local, state, and Federal entities and participants.

- *Resources* – Determine if adequate and cost-effective use was made of all resources available to management.

- *Controls* – Determine the adequacy of overall cost and progress controls in terms of conforming to cost and delivery schedules.

4. DATA RESOURCES

The use of data resources for the quantification of evaluation criteria will be determined by the objectives of the project, the scope of the effort, and the agreed-upon limits of the evaluation report. Sources of data to be considered include the following:

(1) Data Base Files

A data base established and maintained as suggested in Chapter II will provide quantified data prior to system change. The procedures for updating this data should also provide comparison data following the system change.

(2) Equipment Procurement Tests

Tests conducted to determine whether delivered equipment conforms to procurement specifications should provide evaluation data.

(3) System Tests

Data from the performance of system integration and system acceptance tests will be applicable as evaluation data.

(4) Operation Logs

Logs of system operation showing circuit traffic loads, delay time, response time, system reliability, repair, maintenance, and other system operating parameters will provide data for evaluation.

(5) Comparison Data

Data from similar system programs can be valuable in evaluating the new system. Formal evaluation reports should be used where possible. Location of similar system programs and contact with the system administrators may be possible through LEAA regional offices or through APCO.*

*Associated Public Safety Communications Officers, Inc. P.O. Box 669, New Smyrna Beach, Florida 32069.

(6) Statistical Reports

Law enforcement and criminal justice statistics generated locally and nationally assist in evaluating the attainment of objectives and goals. These reports will include:

- Uniform Crime Reports (UCR)
- Court records of case loads and sentencing
- Police department force work load reports
- Detention and corrections records
- Special crime study reports.

Care should be exercised in the use of statistics that were generated for other needs. The full nature of the statistics, what they represent, their limitations, and their probable error should be fully understood before using them for another purpose.

A properly conducted postimplementation evaluation is second in importance only to the program implementation plan. The determination of evaluation criteria early in the program planning will ensure that all program iterations and measurements will be decided on the basis of their beneficial effect on the evaluation score. This will ensure maximum application of resources to the attainment of the program goals and objectives, and will assist in obtaining continued support for the program and for future programs.

CHECKLIST

XIII. POSTIMPLEMENTATION EVALUATION

1. Is there a formally documented postimplementation procedure and plan? ☐
2. Does the postimplementation evaluation plan relate directly to project goals and objectives? ☐
3. Has the responsibility for postimplementation evaluation been clearly assigned? ☐
4. Does the evaluation plan call for the collection of data during system test and acceptance? ☐
5. Has the evaluation plan included the measure of system effectiveness? ☐
   - Are planned organization roles carried out? ____
   - Is the system used as it was intended? ____
   - Is the system performing as planned? ____
6. Has the evaluation plan included the measure of technical performance? ☐
   - Does the equipment meet specification? ____
   - Does the reliability meet specification? ____
   - Is maintainability evaluated? ____
   - Is vendor support service evaluated? ____
7. Has the evaluation plan included the measure of financial performance? ☐
   - Is actual cost measured against budget? ____
   - Are financial controls and reports evaluated? ____
8. Has the evaluation plan included the measure of project management performance? ☐

9. Is adequate use made of all available data sources in the evaluation plan? ☐

Is the data base used? ____

Is performance test data used? ____

Is system test data used? ____

Is operation log data used? ____

Are comparisons made with other systems? ____

Are available statistical reports used? ____

APPENDIX A

HYPOTHETICAL PLANNING SCENARIO

APPENDIX A

HYPOTHETICAL PLANNING SCENARIO

The following example of a law enforcement telecommunications planning and development effort is representative of conditions and constraints existing in actual planning environments. Although the agency is not identified in the text as an existing police department, all of its characteristics have been experienced in recent system design efforts.

1. DESCRIPTION

Old City is the industrial hub of an otherwise rural county. It lies in a shallow valley surrounded by steep hills. Good Town surrounds Old City on three sides and is largely hilly terrain with small farms, recreation areas, and county roads.

All municipal offices for Old City, including the Police Department, are located at City Hall. All municipal offices for Good Town, including its Police Department, are located 4 miles from City Hall in the Town Municipal Building. Other nearby law enforcement agencies include the County Sheriff located at the County Seat 13 miles south of Old City where the State Highway Patrol also maintains a substation.

Table A-1 presents additional descriptive data of Old City and Good Town.

2. BACKGROUND

Five years ago, a long established city administration of Old City was replaced, and extensive programs directed toward city renewal were instituted. The Police Chief of Old City resigned and the Police Department reorganized. The former Chief is now the Police Chief of Good Town and has, with very limited funds, developed a small but highly professional police agency.

The County Sheriff's Department recently organized a countywide mutual-aid low-band radio channel for use by all county police agencies. As of the date of this plan, neither Old City Police Department nor Good Town Police Department has participated in this network organization.

Table A-1
Descriptive Data

Item	Old City	Good Town
Population		
1970	100,217	13,512
1960	87,771	15,182
Average Trend	+1.4% annually	-1.1% annually
Occupied Family Units–1970	30,374	4,045
Land Area	127 sq. mi.	197 sq. mi.
Classification	Urban	Rural
Industry	Light Manufacturing	Agriculture and Recreation

The State Highway Patrol mobiles do not carry the low-band mutual-aid channel and can communicate only with each other or their substation at the County Seat. The Sheriff's Department's low-band mutual-aid channel is monitored at the State Highway Patrol substation and the State Highway Patrol's high-band channel is monitored by the Sheriff's Department, enabling point-to-point cross-band communications between the two.

Good Town Police Department previously had radio coverage problems due to the terrain within the town boundaries. With support from grant funds, it has just installed a new remote base station on Very High Mountain north of Old City with a microwave control link to the Town Municipal Building. All town patrol vehicles have new four-channel VHF low-band transceivers less than 3 years old.

A series of meetings between the Old City Police Department and the Good Town Police Department addressed the communications interface between the law enforcement agencies shown in Table A-2. As a result of these meetings, Lt. Fellow of the Old City Police Department, Staff Services, was given the responsibility for planning a new

telecommunications system and to develop a coordinated communications system for the city and town police agencies. He is to prepare grant requests for LEAA funding and to implement the program. He was designated the Program Director for both police agencies. A joint resolution to this effect has been drawn up and approved by the City Council and the Town Council.

Table A-2
Matrix of Existing Radio Communications Between Agencies

Agency	City P.D.	Town P.D.	County Sheriff	Highway Patrol
City P.D.		No	No	No
Town P.D.	No		No	No
County Sheriff	No	No		Yes
Highway Patrol	No	No	Yes	

As shown in Table A-2, the law enforcement agencies do not have radio communications capability with each other, except that the County Sheriff and the highway patrol can, through monitor receivers, effect cross-band communications.

3. PLANNING PROCESS

The accomplishment of the specific objectives assigned to Lt. Fellow requires the development of a short-range implementation plan. While the problems of interagency coordination involve many facets, the responsibility for solving only the communications aspect has been assigned to Lt. Fellow. The Lieutenant recognizes that the development of an effective plan will require the accomplishment of the following steps:

- *Establish a Data Base* – The needed inventory files, technical files and management files must be accumulated from the two police agencies. The technical file data will remain with the resource agencies and be available from those agencies as required.

- *Identify the Objectives and Requirements* – The objectives, as established in interdepartment meetings, must be defined by the identification of specific requirements and tasks needed to accomplish those objectives.

- *Determine the System Considerations* – The system will need both land line and radio system design. Therefore, the resulting plan must consider the technical, geographic, interface and managerial problems of both these types of systems.

- *Develop the Planning Assumptions* – A list of assumptions relative to the availability of financial, legal, managerial and environmental resources needed for the accomplishment of the plan must be developed.

- *Develop Alternative System Concepts* – The development of alternative system concepts suggests inputs from several resource agencies. These would include, for example:

  - Both Police Departments
  - The County Sheriff's Department
  - The State Highway Patrol Communicators
  - The State Office or Department of Telecommunications
  - The State Planning Agency
  - The APCO Frequency Coordinator

- *Select a System Concept* – Lt. Fellow's department lacks the needed in-house engineering skills. Therefore professional assistance from a qualified consultant will be required to assist in the selection of the concept and the final system design. The concept selected must meet the approval of both agencies and have the support of the elected officials. Obtaining this support will be an important task in the implementation plan.

- *Determine the Program Funding* -- Both town and city budget approvals will be needed for grant matching funds and for future system operating funds. Preapplications for Federal grant funds will be filed as soon as the preliminary design permits. Initial funding will be needed to pay for the consulting services and the initial cost of the planning process.

- *Select the Procurement Method* – Following the selection of the system concept the method of procurement must be determined. This decision will be based upon the scope of the technical problem, the resources available, and the approval of the affected agencies.

- *Define the Environment and Develop a Final System Design* – The final system design will be done by a consulting contractor with the approval of the affected agencies. The environment definition will be dependent upon the system design finally selected, and its incorporation into the procurement package will be the responsibility of the consulting contractor.

- *Develop the Implementation Plan* – A planning document will be developed assigning authority and responsibility for each function needed for implementation. The consultant's services are planned for the preparation of procurement specifications and for the technical evaluation of the offeror's proposals.

- *Develop the Specifications* – The system and equipment procurement specifications will be the responsibility of the consulting contractor.

- *Procure the System* – The plan must identify responsibility for procurement management and supervision. Procurement responsibilities and authorities will have to be designated.

- *Develop the Evaluation Plan* – An evaluation plan will be developed for accumulating data during the system tests to confirm the degree by which the system implemented meets the objectives.

4. DATA BASE

The small number of agencies to be included in the data survey, their close geographic location to each other, and the personal relationship Lt. Fellow has with each of them indicate that personal interviews by Lt. Fellow with telephone follow-up would be the most appropriate method of compiling the needed data. A checklist was prepared to assist Lt. Fellow in organizing the data collection effort. The checklist is shown in Table A-3.

The summation of the hardware inventory data is shown in Table A-4. The summation of agency management data is shown in Table A-5. The location and availability of the technical data are noted so that they might be found easily when needed.

Table A-3
Data Checklist

Inventory File

Location of the Base Station_____ No. Transmitters_____

Transmitter Power Output_____ Radiated Power_____

Antenna Location, Lat._____ Long._____

Antenna, Ht. (ASL)_____ Model_____ Gain_____ Pattern_____

Location of Control Console_____ No. of Positions_____

Emergency Power Capacity, Base Station_____ Control Point_____

Control Links

Wireline, Tone_____ DC_____ Distance_____

Radio, Frequency_____ No. Channels_____ Distance_____

Complaint Consoles, Location_____ Type_____ No. of Positions_____

Mobile Radios, No._____ Age_____ No. Channels Ea._____

Portable Radios, No._____ Age_____ No. Channels Ea._____

Battery Chargers, No._____ Age_____ No. Channels Ea._____

Management File

No. Full Time Personnel, Sworn_____ Civilian_____

No. Part Time Personnel, Sworn_____ Civilian_____

Vehicles, Patrol_____ Admin._____ Motorcycles_____ Other_____

Telephone Lines, Emergency_____ Administration_____

No. of Dispatchers_____ Shift_____

No. of Complaint Operators_____ Shift_____ Sworn/Civ.?_____

Average No. Tel. Calls per Day

Emergency, Police_____ Fire/Rescue_____

Administrative, Incoming_____ Outgoing_____

Maintenance Costs/Yr., Base Station_____ Mobiles_____ Portables_____

Link_____

Lease Cost/Yr., Equipment_____ Telephone Service_____

Training Costs/Yr., Dispatchers_____ Maintenance_____

Table A-4
Hardware Inventory Summation

Item	Old City	Good Township
Base Station Transmitter (Dual Channel)	2 (1 standby)	2 (1 standby)
Base Station Power	120 w	100 w
Base Station Location	City Hall	No. 1—Very High Mt. No. 2—Municipal Bldg.
Base Station Control Location	City Hall	Municipal Bldg.
Distance—Control to Transmitter	93 ft.	No. 1—12 miles No. 2—23 ft.
Control Links	Wire	No. 1—Microwave No. 2—Wire
Logging Recorder	10 channels	None
Dispatching Console (Desk Top)	1	1
Complaint Console	Telephone switchboard	Telephone switchboard
Base Station Antenna Height (ASL)	422 ft.	1,840 ft.
Base Station Antenna Pattern	Omnidirectional	Cardioid (N/S)
Base Station Antenna Gain	5 db	13 db front to back
Base Station Emergency Power	50 Kva	5 Kva (No. 1)
Emergency Power at Control Point	Above	20 Kva (No. 2)
Mobile Radios Total	41	9
5 years old or less (4 channel)	12	9
5 to 10 years old (4 channel)	15	0
over 10 years old (2 channel)	14	0
Portable Radios (all less than 5 years old)		
VHF Low Band—Dual Channel	25	3
VHF High Band—Dual Channel	10	0
Battery Charges		
Multiple Units	3	1
Single Unit	4	1

Table A-5
Management Data Summation

Item	Old City	Good Township
Full-Time Sworn Personnel	93	12
Part-Time Sworn Personnel	11	2
Full-Time Civilian Personnel	6	2
Part-Time Civilian Personnel	3	1
Patrol Vehicles	22	5
Unmarked Vehicles	7	0
Administrative Vehicles	3	2
Motorcycles	3	0
Other Vehicles	5 (motor scooters)	2 (boats)
Emergency Telephone Lines	0*	3
Administrative Telephone Lines	5	Above
Police Dispatchers	4	3
Police Complaint Operators	3	Above
Logged Police Emergency Calls (Average)	144 per day	19 calls per day
Logged Fire/Rescue Calls (Average)	10 per day	9 calls per week
Estimated Police Administrative Calls		
Inbound Calls	290 per day	25 per day
Outgoing Calls	480 per day	42 per day
Equipment Maintenance Costs (Annual)		
Base Station Costs per Unit	$361.00	$292.50
Mobile Costs per Unit	$ 71.50	$ 29.04
Portable Costs per Unit	$ 40.39	$ 44.07
Microwave Link Costs	0	$187.10
Lease Costs for Equipment (Annual)	$1200	0
Telephone Line Costs	$3000	$1800
Training Costs—Communications (Annual)	$850	0

* All telephones have City Hall number.

Potential communications system traffic loads depend in part on demographic data. Population and economic projections for the area show that Old City is experiencing a relatively slow growth rate. Good Town is expected to decrease in population but planned expansion of its recreation industry will cause a sharp seasonal increase in the number of tourists in both summer and winter. As a result, Good Town is expected to add three new patrol vehicles and seven more full-time sworn personnel. The Old City Police Department has planned for no changes in size or increase in patrol facilities.

Citizen access for law enforcement services in Old City is accomplished by their dialing a single-line number which terminates at the municipal switchboard located in the Police Department. This single-line number is used for citizen access to all municipal departments of the city in addition to the Police Department, and, as a result, is often busy on administrative matters during normal daytime working hours. This telephone arrangement results in an undesirable circumstance for any citizen seeking emergency law enforcement assistance.

The switchboard serving the Police Department and other municipal departments of Old City is manned by a civilian telephone operator during normal working hours and by a police officer at all other times. Unfortunately, this work function cannot accomodate the radio dispatcher functions for the Police Department since the switchboard (complaint operator) is in a different room than the remaining communications center resources. The separate communications center is manned by a civilian dispatcher during normal working hours with a police officer dispatching at all other times. The established existing resources of the Police Department communications center are:

- Desk-type radio control console
- CRT data terminal – State Motor Vehicle Department
- Teletype terminal – State Criminal Justice Information System (CJIS)
- One VHF Low-Band Simplex Channel – Police
- One VHF Low-Band Simplex Channel – Fire/Rescue
- One VHF Low-Band Simplex Channel – Local Government

Good Town has a separate Police Department telephone number. Peak-load emergency calls occur outside the normal working hours and there has been no history of telephone busy signal problems. The switchboard is located in the Police Department and is manned by a civilian operator during normal working hours and by police personnel at all other times. The telephone operator is also the dispatcher for all municipal radios and has available the following channels:

- One VHF Low-band Simplex Channel – Police
- One VHF Low-band Simplex Channel – Mutual-Aid/Fire/Rescue
- One VHF Low-band Simplex Channel – Local Government.

Motor Vehicle Department data and CJIS data are provided by telephone from the Old City Police Department and from the County Sheriff's Department.

Neither police agency reports problems of radio coverage, radio channel congestion, or interference from co-channel users. The mountain top directional antenna pattern alleviates interference with a police agency to the north of the town.

5. GOALS, OBJECTIVES AND REQUIREMENTS

Project goals were established during the original meetings between the police agencies and were spelled out in a joint resolution signed by both political bodies. The project goals, objectives and requirements are limited to the communications aspects of the problem and do not impose the more general problems of community law enforcement and crime prevention which were beyond the authority and responsibility of Lt. Fellow's assignment. These goals are:

- To provide communications capabilities needed for the close operational coordination between the agencies
- To reduce delay time and extend the capabilities of the law enforcement communications process
- To implement these improvements in the most cost-effective manner.

From these goals, a list of program objectives was developed and approved. A two-year period was established as the time within which to accomplish the necessary objectives. The objectives are:

- To improve citizen access to police and thereby reduce delay time to citizen complaint calls
- To develop a region-wide tactical telecommunications network
- To develop a consolidated shared facility for the use of both police agencies.

The program requirements needed to attain the objectives include:

- Implementation of an emergency telephone system for Old City Police Department with the probability of a busy signal of 0.01 or less
- Provision of a police telephone number for citizen emergency access to the Old City Police Department
- Provision of tactical radio communications system with mobile-to-mobile and portable-to-portable capability between the units of both police agencies
- Provision of interagency point-to-point radio coordination capability
- Ensurance of channel capacity needed to meet functional needs (dispatch, tactical, and coordination) and ensure ready access to the radio channel within 10 seconds by any unit of either agency.

6. SYSTEM CONSIDERATIONS

The system considerations that must be satisfied by the plan include three general areas responsive to the goals of the program. The following paragraphs identify these considerations by major area:

(1) Citizen Access

Citizen access to the Town Police is adequate. However, the citizen access telephone system for the City Police does not satisfy the needs of the community and must be improved. The improvements must:

- Reduce the probability of a busy signal for complaint calls to the Police Department
- Reduce the time required to reach the Police that currently results from routing the call through the City Hall switchboard.

(2) Regional Interagency Telecommunications

The system should provide routine telecommunications capability between the following agencies and units:

- City Police and Town Police – both base and mobile
- City and Town Police and the County Sheriff
- City and Town Police and County Mutual-Aid Network
- City and Town Police and State Highway Patrol
- City and Town Base Station and any City or Town mobile unit
- Mobile-to-mobile – either City or Town or both.

(3) **Shared Facilities and Resources**

Mutual use of the law enforcement resources should be planned to provide both police agencies with greater effectiveness at lower cost by:

- Access by mobiles of either agency to the data bank terminals at Old City Police Department
- Use and control of all transmitters by either agency
- Control of full system operation from consoles at either agency
- Operation of all mobiles and portables of either agency on the frequency assigned to the other agency
- System operation in a degraded mode during periods of emergencies or disasters.

An important constraint that Lt. Fellow encountered during initial interviews with Good Town officials limits the sharing of police dispatch facilities. Specifically, Lt. Fellow was informed that the Town Council of Good Town was unlikely to approve participation in a public-safety communications plan that would result in the full-time dispatch of its police units by a party other than its own police department. However, to illustrate the potential savings that could result from centralized dispatch facilities, Lt. Fellow decided to ignore this jurisdictional constraint in the development of alternative concepts.

7. DEVELOPING ALTERNATIVE CONCEPTS

In developing alternative concepts Lt. Fellow recognized the following organization of the problem:

- *Citizen Access* – The development of alternatives relative to the telephone system design to improve citizen access to the police departments
- *Operational Communications* – The development of alternatives relative to the improvement of agency communications capabilities
- *Interagency Coordination* – The development of alternatives relative to the implementation of communications interfaces between the agencies.

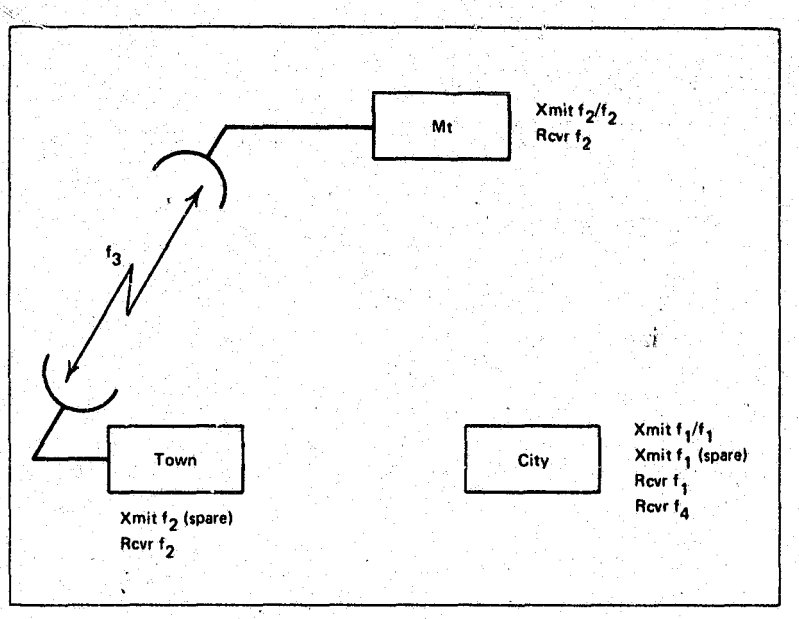
(1) Citizen Access

Four alternative concepts for improving citizen access to the City and Town police were considered. These are:

- *911 Emergency System* – The implementation of a 911 emergency telephone system that would include both the City and Town emergency services
- *Area Emergency Telephone Number* – The implementation of a single, easily remembered, 7-digit telephone number that would serve both the City and Town emergency services
- *City Police Emergency Number* – The installation of a police emergency number for the City Police Department
- *Improve City Hall Service* – Install more telephone lines and employ more telephone operators at City Hall to reduce the "busy signal" problem for all municipal departments including the police.

(2) Operational Communications

The existing Radio System for the Town and the City is shown in Figure A-1. The alternatives for the new radio system must include the aspects of both operational communications and interagency coordination. The radio system alternative concepts are also bounded by the following conditions:



Frequency Legend:

f_1 = City Police - Lo Band
f_2 = Town Police - Lo Band
f_3 = Microwave Control Link
f_4 = Surveillance - Hi Band

FIGURE A-1

Existing Radio System

- Propagation coverage for both City and Town police on their operational frequencies is adequate within their boundaries.

- Propagation on low-band has been demonstrated to be adequate countywide from the mountain transmitter location.

- Maximum use should be made of the existing radio equipment in both police agencies.

- A previously licensed but underused low-band frequency is available for an additional tactical frequency.

- The FCC will not license additional base stations or mobiles on the State Highway Patrol's new high-band frequencies.

- Cross-band monitoring techniques with tone-coded squelch provisions have been demonstrated to be adequate in providing communications with the Sheriff and the Highway Patrol without direct use of their frequency channels.

Within these conditions, four radio system alternative concepts as shown in Figure A-2 are considered. These are:

1. Separate duplicate radio transmitter, receiver and control console systems for the City and the Town police agencies

2. Interconnect the City and Town control consoles to make cooperative use of existing transmitter sites

3. Consolidate all transmitters except the mountain top transmitter at a mutually accessible transmitter site and connect both control consoles to this site

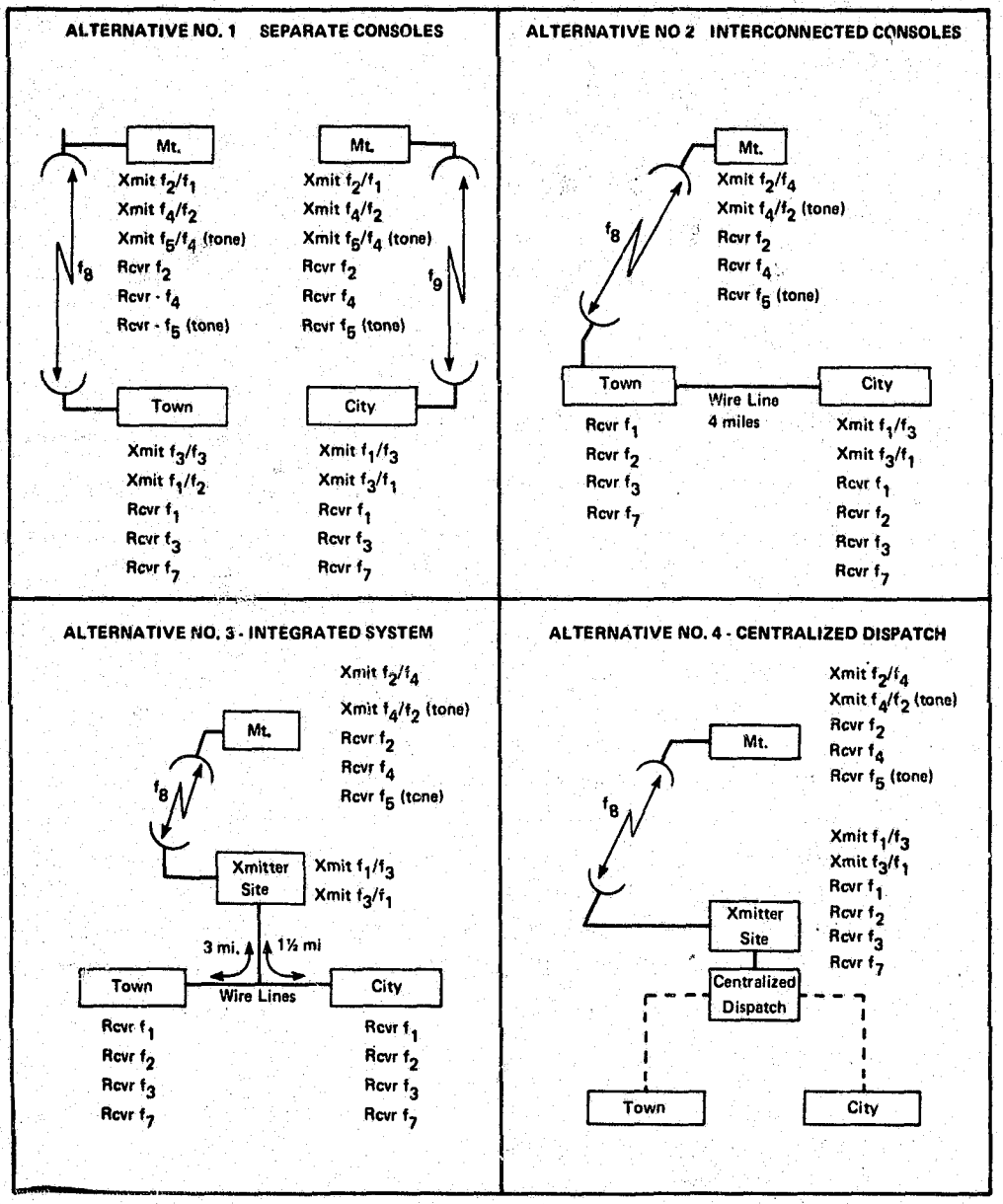
4. Implement a centralized public-safety dispatch center for both the City and the Town police. As noted above, this concept is evaluated to illustrate the potential savings that could be realized by both governmental units if this alternative were acceptable to Good Town officials.

(3) Interagency Coordination

Aspects of interagency coordination that are not related to the equipment configuration involve operating agreements that must be established at the management levels of the City Police Department and the Town Police Department. For Lt. Fellow's planning purposes, he was instructed by the two Chiefs to provide for the operation of the Town radio console only during the normal business day. The functions of that console are to be switched to the City Police console at all other times. The Chiefs will determine any additional operational procedures needed by the system.

8. SELECTING THE CONCEPT

In presenting alternate concepts for evaluation, Lt. Fellow considered all technically feasible solutions that met the previously established conditions of creating a method of interagency communication with minimum change to the existing radio system. He was aware of certain prejudicial feelings that exist between the two political entities, but he looked to higher authority for rulings that involved factors other than operational and technical feasibility.



FREQUENCY LEGEND

f_1 = City Police - Lo Band
f_2 = Town Police - Lo Band
f_3 = Local Tactical Freq. - Lo Band
f_4 = Mutual Aid - Lo Band

(Tone) = Tone controlled squelch encode or decode

f_5 = County Sheriff - Lo Band
f_6 = Surveillance - Hi Band
f_7 = Portable Transmit Only - Lo Band
f_8 = Microwave Link No. 1
f_9 = Microwave Link No. 2

FIGURE A-2
Radio System Alternatives

(1) Citizen Access

The 911 emergency telephone system concept was discussed with representatives of the telephone company. Lt. Fellow was informed that the necessary telephone switching equipment could not be implemented in the region within the next five years. The 911 concept was therefore rejected as an alternate solution.

The concept of a single areawide 7-digit telephone number for all Town and City emergency services offered no advantages to the Town Police Department which was well satisfied with its own telephone system. The Town Council informed Lt. Fellow that it would not approve a plan that included the loss of its long-established police emergency telephone number.

The program requirement for a busy signal probability of 0.01 when calling the police during the peak traffic hour and the 0.01 probability of not having a ring answered within 30 seconds during the peak traffic hour was confirmed by the telephone company technical staff as a reasonable requirement for a system receiving 144 calls a day on the average with a peak of 12 calls at the busiest hour. The City Hall switchboard has demonstrated a significantly lower probability than this for the present City Hall telephone system. To provide enough additional telephone lines and enough additional operator positions to the City Hall system to meet the emergency telephone requirements of the Police Department during the peak daytime traffic load for all municipal departments in the City Hall would result in a substantially higher recurring telephone charge. This could not be justified by the needs of the other municipal departments. The Mayor, upon advice of the City Auditor, informed Lt. Fellow that it was not feasible to add the needed capacity to the City Hall telephone systems and that the Police Department should proceed at once to determine the needs of its own emergency telephone system. The Police Department administrative telephones will remain as part of the existing City Hall system.

Applying queueing analysis techniques to the peak hour emergency police calls for the Town Police and the City Police confirmed that one complaint operator/dispatcher is adequate for the Town Police and no telephone system change is required. The queueing analysis was performed for the City Police Department using the average of 12 emergency calls during the peak traffic hour and an average emergency call length of 90 seconds as determined from the telephone data logs. The options within the needs of the system requirements and the corresponding probabilities calculated from a queueing analysis are shown in Table A-6.

The table shows that for a probability of 0.01 or less that the call will result in a "busy" signal, three telephone lines will be required. For a probability of 0.01 or

less that the ring will be answered within 30 seconds (about 5 rings), three operator positions will be needed. The three lines can be answered by the police at the telephone switchboard, at the Desk Sergeant's position, and at the radio dispatch console with minimum change in the department's operating procedure. This concept meets the needs for prompt citizen access to the police department and results in a minimum change in the department's operating procedures. It is therefore selected for implementation.

Table A-6
Emergency Telephone System Options
Old City Police Department

Option	Busy-Signal Probability	Option	30-Sec Wait Probability
Two Lines	.035	One Operator	.24
Three Lines	.0025	Two Operators	.02
		Three Operators	.0015

(2) Operational Communications

A review of the operational aspects of the alternative concepts by outside agencies and by both Town and City officials will assure that the concepts shown in Figure A-2 will meet the following criteria:

- Technical feasibility
- Compatibility with existing system
- Acceptability by the users
- Achievement of goals and objectives
- Legality.

Included in this review were the following outside agencies:

- State Planning Agency
- State Director of Telecommunications
- State's Attorney General's Office
- State Highway Patrol Communications Division
- APCO Frequency Coordinator.

The goals and requirements developed for the project were clearly expressed, and all four alternative concepts will attain these goals and objectives. It was not necessary for Lt. Fellow to consider a less than fully capable concept. It should be noted, however, that Alternate Number 2, Interconnected Consoles, provides back-up control consoles giving either agency access to a degraded system that may result from a natural disaster disabling the mountain top transmitter or one of the control consoles. This redundant back-up system is not so clearly evident in Alternate Number 4, Centralized Dispatch. Since the cost difference between the competing systems are of extreme importance to the evaluators and elected officials, each of the competing concepts was analyzed in terms of implementation costs and recurring operation costs. The summation of the investment costs for each alternative concept is shown in Table A-7 and the summation of the annual recurring costs for each alternative concept is shown in Table A-8.

In deciding the quality of equipment to be purchased and, therefore, the price per unit used to develop Table A-7, Lt. Fellow computed the present value of the expected costs that would be incurred over the expected lives of the competing equipments. The present value of the costs is the amount which, if placed in an investment with a yield equal to the discount rate at the beginning of the initial year, would produce the funds that are needed to cover all costs that will be incurred from the time its equipment is acquired until it is no longer useful. Lt. Fellow plans to recommend the quality of equipment that will result in the lowest costs to Old City and New Town over the life of each type of equipment.

The data needed for this analysis includes both the initial equipment cost as well as the annual maintenance and repair costs over the equipment's expected life. Lt. Fellow acquired price quotes and estimates of the expected period of useful service from vendor representatives and from existing users of the equipment being considered. The initial costs were reduced to the amount that would be born by Old City and New Town using preliminary cost sharing ratios and entered as shown in Tables A-9 and A-10 opposite year zero. Annual maintenance costs for the different qualities of equipment are estimated from State Highway Patrol records and entered for each year in the useful life of the equipment. These years, as shown in Tables A-9 and A-10, begin with the first year of system operation (year 1) and end with the last year that the equipment is assumed to provide useful service. Note that the same number of years are used in the evaluation of each type of equipment; that is, 7 years is used for all mobile radio lines, 5 years for all portable radio lines, and 13 years for all radio base station equipment lines.

After obtaining the cost data, Lt. Fellow multiplies the costs for each year by the appropriate discount factor to obtain the present value of that year's costs. These annual present value costs are then summed to obtain the total present value of the costs for the particular equipment line. A discount rate of 9 percent was selected for all calculations. This rate corresponds with the prevailing bond rate for the city. (See Table 11.)

The present value analysis of available cost data indicates to Lt. Fellow that difference in investment costs between the top line equipment and the medium line equipment, after adjustment for cost sharing, was eroded by differences in recurring cost values over the life span of the equipment. For example, the present value analysis shows a present value cost advantage of $502 for top line radio base station unit costs relative to medium line equipment. This result, summarized from Table A-10 is as follows:

	Unit Costs		
Radio Base Station Equipment	**Initial***	**Recurring Per Year**	**Total Present Value**
Top line	$1,767	$528	$5,941
Medium line	1,250	657	6,443
	+517	-129	-502

*Initial costs of $5,300 and $3,750 for top and medium lines, respectively, have been reduced to $767 and $1,250 to account for expected cost sharing.

In other words, the present value analysis shows that the additional $517 in the local share of initial costs that will be incurred immediately for the top line are offset by annual savings in recurring costs that will be incurred in future years of the system's useful life, when these future savings are weighted by the time value of money. Based on these savings, Lt. Fellow elected to base his cost estimates upon the top line equipment costs.

After selecting the equipment for each design concept, Lt. Fellow prepared a cost benefit analysis depicting the cost of ownership of each competing system concept for both the Town and the City as compared to the cost of operating the existing system. Lt. Fellow required the assistance of both Police Chiefs and the financial staffs of both the Town and the City in order to establish the costs of operating the present system and to establish a preliminary agreement regarding the sharing of costs for the coordinated mutual-access communications systems being proposed. The decision was made to show these costs as a variance from the costs of the present system so that cost benefits would be defined clearly.

Table 7
Summation of Investment Cost Factors

	Alternate No. 1	Alternate No. 2	Alternate No. 3	Alternate No. 4
Cost Factor	Separate Consoles	Interconnected Consoles	Integrated System	Centralized Dispatch
New Base Transmitters	$ 26,500	$ 5,300	$ 5,300	$ 5,300
New Base Receivers	3,376	2,954	2,954	1,266
New Console	42,740	42,740	42,740	20,500
New Mobile Radios	48,000	48,000	48,000	48,000
New Portable Radios	11,640	11,640	11,640	11,640
New Building	43,000	–	–	–
Remodel Old Building	–	–	27,200	33,710
New Antenna Tower	1,140	–	–	–
New Microwave Link	9,700	–	–	–
Telephone Installation	950	1,430	1,910	1,200
Emergency Generator	1,100	–	1,100	1,100
Moving and Rigging	6,200	1,100	3,050	4,150
Total	$194,346	$113,164	$143,894	$126,866

Table 8
Summation of Annual Recurring Cost Factors

Cost Factor	Present System	Alternate No. 1 Separate Consoles	Alternate No. 2 Interconnected Consoles	Alternate No. 3 Integrated System	Alternate No. 4 Centralized Dispatch
Maintenance	$ 6,022	$ 8,079	$ 6,022	$ 6,022	$ 5,562
Lease Cost	6,895	9,144	9,936	14,568	10,380
Labor	103,250	103,250	70,400	70,400	51,000
Training	2,249	2,923	2,249	2,249	1,870
Supplies	1,350	1,470	1,350	1,350	1,250
Contract Service	1,200	1,950	1,200	1,200	2,020
Total	$120,966	$126,816	$91,157	$95,789	$72,082

*The Chart of Accounts for the municipal governments of Old City and Good Town has no accounting provisions for the depreciation of capital goods such as radio equipment. For this reason, the amortization of the purchase price over the life of the equipment was not used in estimating the annual recurring cost of each alternative.

Only recurring operating costs were included in the cost benefit analysis by decision of the financial staff. This was based on the minimal financial, importance of investment costs to the Town and the City after receipt of anticipated grant funds. With the assumption that preliminary cost sharing ratios would be approved for each competing system concept, Table A-12 shows the summation of the recurring cost variance from the present operating costs of $120,966 for the existing radio system in both the Town and the City. For example, Table 12 shows that Alternate Number 2 will cost $29,809 a year less to operate than the existing system, and of this the Town will pay $18,763 a year less than it now pays and the City will pay $11,046 a year less than it now pays.

Table A-9
Preliminary Present Value Analysis
Mobile Radios and Portable Radios

Years	Mobile - Top Line			Mobile - Medium Line		
	Cost	Discount Factor*	Present Value	Cost	Discount Factor*	Present Value
0	$500**	1.0000	$ 500.00	$450**	1.0000	$ 450.00
1	110	.9259	101.85	132	.9259	122.22
2	110	.8573	94.30	132	.8573	113.16
3	110	.7938	87.31	132	.7938	104.78
4	110	.7350	80.85	132	.7350	97.02
5	110	.6806	74.87	132	.6806	89.84
6	110	.6302	69.32	132	.6302	83.19
7	110	.5835	64.19	132	.5835	77.02
Total Present Value			$1072.69	Total Present Value		$1137.23

Years	Portables - Top Line			Portables - Medium Line		
	Cost	Discount Factor*	Present Value	Cost	Discount Factor*	Present Value
0	$323.33***	1.0000	$323.33	$283.33***	1.0000	$283.33
1	35.00	.9259	32.41	49.00	.9259	45.37
2	35.00	.8573	30.01	49.00	.8573	42.01
3	35.00	.7938	27.78	49.00	.7938	38.90
4	35.00	.7350	25.73	49.00	.7350	36.02
5	35.00	.6806	23.82	49.00	.6806	33.35
Total Present Value			$463.08	Total Present Value		$478.98

* See Table 11 for 8%.

** Mobile radio top line initial costs of $1500 per unit and medium line costs of $1350 per unit have been reduced to $500 and $450 per unit, respectively, to account for expected cost sharing.

*** Portable radio top line initial costs of $970 per unit and medium line costs of $850 per unit have been reduced to $323.33 and $283.33, respectively, to account for cost sharing.

Table A-10
Preliminary Present Value Analysis
Radio Base Stations

Years	Base Station - Top Line			Base Station - Medium Line		
	Cost	Discount Factor*	Present Value	Cost	Discount Factor*	Present Value
0	$1,767**	1.0000	$1,767.00	$1,250**	1.0000	$1,250.00
1	528	.9259	488.88	657	.9259	608.32
2	528	.8573	452.65	657	.8573	563.25
3	528	.7938	419.13	657	.7938	521.53
4	528	.7350	388.08	657	.7350	482.90
5	528	.6806	359.36	657	.6806	447.15
6	528	.6302	332.75	657	.6302	414.04
7	528	.5835	308.09	657	.5835	383.36
8	528	.5403	285.78	657	.5403	354.98
9	528	.5002	264.11	657	.5002	328.63
10	528	.4632	244.57	657	.4632	304.32
11	528	.4289	226.46	657	.4289	281.79
12	528	.3971	209.67	657	.3971	260.89
13	528	.3677	194.15	657	.3677	241.58
Total Present Value			$5,940.68	Total Present Value		$6,442.74

* See Table 11 for 8%.

** Initial costs of $5,300 and $3,750 for Top and Medium Lines, respectively, have been reduced to $1,767 and $1,250 to account for expected cost sharing.

Table A-11
Present Value Discount Factors
Present Value of a Single Sum

PRESENT VALUE OF 1 $V^n = \frac{1}{(1+i)^n}$

n	½%	1%	2%	3%	4%	5%	6%	8%	10%	12%	16%
1	0.9950	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9259	0.9091	0.8929	0.862
2	0.9901	0.9803	0.9612	0.9426	0.9246	0.9070	0.8900	0.8573	0.8264	0.7972	0.743
3	0.9851	0.9706	0.9423	0.9151	0.8890	0.8638	0.8396	0.7938	0.7513	0.7118	0.641
4	0.9802	0.9610	0.9238	0.8885	0.8548	0.8227	0.7921	0.7350	0.6830	0.6355	0.552
5	0.9754	0.9515	0.9057	0.8626	0.8219	0.7835	0.7473	0.6806	0.6209	0.5674	0.476
6	0.9705	0.9420	0.8880	0.8375	0.7903	0.7462	0.7050	0.6302	0.5645	0.5066	0.410
7	0.9657	0.9327	0.8706	0.8131	0.7599	0.7107	0.6651	0.5835	0.5132	0.4523	0.354
8	0.9609	0.9235	0.8535	0.7894	0.7307	0.6768	0.6274	0.5403	0.4665	0.4039	0.305
9	0.9561	0.9143	0.8368	0.7664	0.7026	0.6446	0.5919	0.5002	0.4241	0.3606	0.263
10	0.9513	0.9053	0.8203	0.7441	0.6756	0.6139	0.5584	0.4632	0.3855	0.3220	0.227
11	0.9466	0.8963	0.8043	0.7224	0.6496	0.5847	0.5268	0.4289	0.3505	0.2875	0.195
12	0.9419	0.8874	0.7885	0.7014	0.6246	0.5568	0.4970	0.3971	0.3186	0.2567	0.168
13	0.9372	0.8787	0.7730	0.6810	0.6006	0.5303	0.4688	0.3677	0.2897	0.2292	0.145
14	0.9326	0.8700	0.7579	0.6611	0.5775	0.5051	0.4423	0.3405	0.2633	0.2046	0.125
15	0.9279	0.8613	0.7430	0.6419	0.5553	0.4810	0.4173	0.3152	0.2394	0.1827	0.108
16	0.9233	0.8528	0.7284	0.6232	0.5339	0.4581	0.3936	0.2919	0.2176	0.1631	0.093
17	0.9187	0.8444	0.7142	0.6050	0.5134	0.4363	0.3714	0.2703	0.1978	0.1456	0.080
18	0.9141	0.8360	0.7002	0.5874	0.4936	0.4155	0.3503	0.2502	0.1799	0.1300	0.069
19	0.9096	0.8277	0.6864	0.5703	0.4746	0.3957	0.3305	0.2317	0.1635	0.1161	0.060
20	0.9051	0.8195	0.6730	0.5537	0.4564	0.3769	0.3118	0.2145	0.1486	0.1037	0.051
21	0.9006	0.8114	0.6598	0.5375	0.4388	0.3589	0.2942	0.1987	0.1351	0.0926	0.044
22	0.8961	0.8034	0.6468	0.5219	0.4220	0.3418	0.2775	0.1839	0.1228	0.0826	0.038
23	0.8916	0.7954	0.6342	0.5067	0.4057	0.3256	0.2618	0.1703	0.1117	0.0738	0.033
24	0.8872	0.7876	0.6217	0.4919	0.3901	0.3101	0.2470	0.1577	0.1015	0.0659	0.028
25	0.8828	0.7798	0.6095	0.4776	0.3751	0.2953	0.2330	0.1460	0.0923	0.0588	0.024
30	0.8610	0.7419	0.5521	0.4120	0.3083	0.2314	0.1741	0.0994	0.0573	0.0334	0.012
35	0.8398	0.7059	0.5000	0.3554	0.2534	0.1813	0.1301	0.0676	0.0356	0.0189	0.007
40	0.8191	0.6717	0.4529	0.3066	0.2083	0.1420	0.0972	0.0460	0.0221	0.0107	0.003
45	0.7990	0.6391	0.4102	0.2644	0.1712	0.1113	0.0727	0.0313	0.0137	0.0061	0.001
50	0.7793	0.6080	0.3715	0.2281	0.1407	0.0872	0.0543	0.0213	0.0085	0.0035	0.001
55	0.7601	0.5785	0.3365	0.1968	0.1157	0.0683	0.0406	0.0145	0.0053	0.0020	0.0003
60	0.7414	0.5504	0.3048	0.1697	0.0951	0.0535	0.0303	0.0099	0.0033	0.0011	0.0001

Table A-12
Summation of Recurring Cost Variance from Present System Recurring Costs

Cost Factor	Alternate No. 1 Separate Consoles		Alternate No. 2 Interconnected Consoles		Alternate No. 3 Integrated System		Alternate No. 4 Centralized Dispatch	
	City	Town	City	Town	City	Town	City	Town
Maintenance	$+3,855	$+205	$ -94	$ +94	$ -94	$ +94	$ -400	$ -60
Lease Cost	$+1,030	0	$ -754	$ +1,546	$+1,562	$ +3,862	$ +2,323	$ +1,167
Labor	0	0	$-10,198	$-20,403	$-10,198	$-20,403	$-25,500	$-25,500
Training	0	0	0	0	0	0	$ -814	$ -820
Supplies	0	0	0	0	0	0	$ -50	$ -50
Contract Svc	$ +375	$+375	0	0	0	0	$ +550	$ +270
Sub Total Variance	$+5,260	$+580	$-11,046	$-18,763	$-8,730	$-16,447	$-23,891	$-24,993
Total Variance	$+5,840		$-29,809		$-25,177		$-48,884	

Note: In this chart a minus sign (-) indicates a cost less than the cost of operating the existing system and a plus sign (+) indicates a cost greater than the cost of operating the existing system.

The analysis of annual cost variance shown in Table A-12 clearly indicates that the most cost-effective system concept is Alternate Number 4, the Centralized Dispatch Center. However, this concept was not acceptable to the Mayor of Good Town and the Town Council, because, as noted above, it entails the dispatch of its police units by persons other than its own police department. Therefore, it was decided that the project would proceed based upon Alternate Number 2, the Interconnected Consoles. This concept is clearly the most cost-effective, acceptable system concept.

9. PROGRAM FUNDING

The cost evaluation procedure has resulted in a reasonably accurate cost estimate needed for system implementation. These early indications of cost levels enable the schedule of funding to be developed and the source of the funds determined. Grant funds must be obtained for the investment costs for the Interconnected Consoles as shown in Table A-7 and to these funds must be added planning costs and the costs of a systems consultant contractor. The annual operating funds for the system as shown in Table A-8 will be budgeted for by the Town and the City for each year following the year of implementation.

(1) Grant Funds

Preapplications are prepared and submitted to the State Planning Agency for Federal grant funds according to the provisions of the State Comprehensive Law Enforcement Plan. In securing the approval of these preapplication forms, a tentative commitment must be developed by both the town government and the city government pledging their share of the system procurement and implementation costs. They must also declare their commitment to the annual operating costs.

(2) Municipal Funds

Both police department budgets are explored for the level of operating funds needed for the new system. The cost variance analysis shown in Table A-9 gives assurance that the budgets of both departments are adequate to support the operation and maintenance of the new system. An agreement must be developed and formalized showing the sharing of funds for both the implementation and operation of the system.

The level of Federal and state grant funds needed for system implementation is estimated and the matching funds calculated. Supported by the analysis of operating

economies disclosed by the cost benefit analysis, budget requests for these matching funds were prepared and submitted to the Town Council and the City Council.

10. PROGRAM IMPLEMENTATION PLAN

A program implementation planning document was prepared by Lt. Fellow. This document will serve as a guide to all involved and affected agencies and persons regarding the following:

- The reasons for the program
- The goals and requirements
- The system concept that was developed
- The sources of funding
- The method of implementation
- The implementation schedule
- The persons responsible for the implementation
- The method and responsibility of procurement
- The system acceptance criteria
- The postimplementation evaluation plan.

The addendum to Appendix A is a copy of this planning document. Upon distribution, this planning document is the key instrument for the delegation of responsibility and authority from Lt. Fellow to the individuals participating in the project over its expected two-year span.

ADDENDUM TO APPENDIX A

HYPOTHETICAL PLANNING DOCUMENT

NOTE: This addendum is a copy of the planning document that was prepared by Lt. Fellow for distribution to agencies and persons affected. Cost figures used in this hypothetical case are for example only and should not be used in performing evaluations of existing or proposed telecommunications systems.

A LAW ENFORCEMENT TELECOMMUNICATIONS PLAN FOR OLD CITY AND GOOD TOWN

1. INTRODUCTION

The development of radio communications for law enforcement agencies in the geographic area that includes Old City and Good Town has, in the past, been concentrated on the individual needs of each agency. Recent developments in the coordination of law enforcement and crime prevention between the agencies has demonstrated the need for direct interagency radio communication. The Police Department of Old City and the Police Department of Good Town do not now have direct radio communications with each other and neither department has direct radio communications with the Blank County Sheriff's Department, the Blank County Mutual Aid Radio Network or the State Highway Patrol. The principal purpose of this program is to provide the means for interagency communications. In addition, the plan will provide radio facilities to enable interagency coordination of law enforcement field activities, provide the capability of mutual aid in times of emergencies or disasters, and improve citizen access to the police services of both communities.

The authority for the planning activity described in this document was granted through a Resolution passed by the City Council of Old City on August 4, 1975, and by the Town Council of Good Town on August 7, 1975. Copies of this Resolution are available from the office of the City Clerk of Old City and from the Town Clerk of Good Town. Attesting to this authority, the signatures of duly authorized officers of Old City and Good Town are affixed to this document.

This planning document is intended to inform, guide and direct agencies and personnel affected either directly or indirectly by the implementation and operation of the improved law enforcement telecommunications system. This document will be revised and amended as the plan matures. The agencies participating directly in this program are:

- The Old City Police Department
- The Old City Department of Public Safety
- The Good Town Police Department
- The Good Town Commissioner of Public Safety.

Other law enforcement agencies that will interface directly with the planned communications system are:

- Blank County Sheriff's Department
- Blank County Commission in Law Enforcement
- State Highway Patrol.

The specific problems to be solved by this program are the following:

- The need for direct radio communications between all base and field units of the City and Town police departments

- The need for direct radio communications between the base units of the City or Town police departments and the County Sheriff's Department, the County Mutual Aid Radio Network, and the State Highway Patrol

- Provide emergency or disaster communications for both police departments through the cooperative use of communications equipment and facilities of either agency

- Provide improved citizen emergency access to the Old City Police Department and reduce the time of response of the communication system to these emergency requests.

2. DATA BASE

Maximum use will be made of the equipment, system configuration, facilities and resources of the public safety communications system as it is now configured in Old City and Good Town. Specifically, the data to be used in planning and implementing the new system are of three general types. These are:

- Equipment Inventory
- Management Data
- Technical and Engineering Data.

The inventory of radio equipment that is applicable to the planned system is shown in Table 1A. This inventory data has been corrected to the date of this planning document and will be used by the planners and the system designers to determine the additional equipment needs of the new system.

Table 1A
Equipment Inventory Summation

Item	Old City	Good Township
Base Station Transmitter (Dual Channel)	2 (1 standby)	2 (1 standby)
Base Station Power	120 w	100 w
Base Station Location	City Hall	No. 1—Very High Mt. No. 2—Municipal Bldg.
Base Station Central Location	City Hall	Municipal Bldg.
Distance—Control to Transmitter	93 ft.	No. 1—12 miles No. 2—23 ft.
Control Links	Wire	No. 1—Microwave No. 2—Wire
Logging Recorder	10 channels	None
Dispatching Console (Desk Top)	1	1
Complaint Console	Telephone switchboard	Telephone switchboard
Base Station Antenna Height (ASL)	422 ft.	1,840 ft.
Base Station Antenna Pattern	Omnidirectional	Cardioid (N/S)
Base Station Antenna Gain	5 db	13 db front to back
Base Station Emergency Power	50 Kva	5 Kva (No. 1)
Emergency Power at Control Point	Above	20 Kva (No. 2)
Mobile Radios Total	41	9
5 years old or less (4 channel)	12	9
5 to 10 years old (4 channel)	15	0
over 10 years old (2 channel)	14	0
Portable Radios (all less than 5 years old)		
VHF Lo Band—Dual Channel	25	3
VHF Hi Band—Dual Channel	10	0
Battery Charges		
Multiple Units	3	1
Single Unit	4	1

Information that is applicable to the estimate of potential use and traffic loads of the new system as well as to the estimate of operating costs of the new system are contained in the management files of the Old City Police Department and the Good Town Police Department. This information has been acquired from these sources and the summation of this data is presented in Table 2A.

All of the source data needed to generate the summations presented in Table 1A and Table 2A has been accumulated and is available from Lt. Fellow of the Old City Police Department, Staff Services.

Technical data related to the equipment in the existing system, the performance characteristics of each item of that equipment and performance measurements of the existing system will be needed by the system designers. This technical data related to the Old City Police Radio System has been accumulated by Staff Services of the Old City Police Department and is available from that office. Similar data related to the Good Town Police Radio System is available from the Chief, Good Town Police Department. The kinds of data available are:

- Specifications for present system hardware items
- Specifications for present system performance parameters
- Installation data for present hardware items
- Propagation test results--Radio coverage maps
- Propagation analysis data for in-service channels
- Logs of traffic loads by type for wirelines and radio
- Queueing analysis for wireline
- Statistical projections of area population growth
- Statistical projections of area demographic trends
- Statistical projections of wireline traffic growth.

3. PROJECT GOALS, OBJECTIVES AND REQUIREMENTS

The goals of the program are the following:

- To provide communications capabilities needed for close operational coordination between the police agencies

- To reduce the delay time between complaint and dispatch and extend the capabilities of the law enforcement communications process

- To implement these improvements in the most cost-effective manner.

Table 2A
Management Data Summation

Item	Old City	Good Township
Full-Time Sworn Personnel	93	12
Part-Time Sworn Personnel	11	2
Full-Time Civilian Personnel	6	2
Part-Time Civilian Personnel	3	1
Patrol Vehicles	22	5
Unmarked Vehicles	7	0
Administrative Vehicles	3	2
Motorcycles	3	0
Other Vehicles	5 (motor scooters)	2 (boats)
Emergency Telephone Lines	0*	3
Administrative Telephone Lines	5	Above
Police Dispatchers	4	3
Police Complaint Operators	3	Above
Logged Police Emergency Calls (Average)	144 per day	19 calls per day
Logged Fire/Rescue Calls (Average)	10 per day	9 calls per week
Estimated Police Administrative Calls		
Inbound Calls	290 per day	25 per day
Outgoing Calls	480 per day	42 per day
Equipment Maintenance Costs (Annual)		
Base Station Costs per Unit	$361.00	$292.50
Mobile Costs per Unit	$ 71.50	$ 29.04
Portable Costs per Unit	$ 40.39	$ 44.07
Microwave Link Costs	0	$187.10
Lease Costs for Equipment (Annual)	$1200	0
Telephone Line Costs	$3000	$1800
Training Costs—Communications (Annual)	$850	0

* All telephones have City Hall number.

From these goals, and in support of these goals, the following program objectives have been determined:

- To improve citizen access to police and thereby reduce delay time to citizen complaint calls
- To develop a region-wide tactical communications network
- To develop a consolidated shared facility for the use of both police agencies.

The program requirements needed to attain the objectives above include, but are not limited to, the following:

- To implement an emergency telephone system for the Old City Police Department with the probability of a busy signal of 0.01 or less
- To provide a police-only telephone number for emergency citizen access to the Old City Police Department
- To provide a tactical radio communications system with mobile-to-mobile and portable-to-portable capability between the units of both police agencies
- To provide interagency point-to-point radio coordination capability
- To ensure the channel capacity needed to meet functional needs (dispatch, tactical and coordination) and to ensure ready access to the radio channel by any unit of either agency.

4. THE SYSTEM CONCEPT

The system concept that has been agreed to and approved by the Old City Police Department, the Good Town Police Department, the City Council of Old City and the Town Council of Good Town has three principal subsystems. These are as follows:

- The citizen access system
- The radio system
- The interagency coordination system.

(1) Citizen Access Subsystem

The citizen access to both City and Town police agencies is by telephone. No change is contemplated in the Town telephone system.

The access to the City Police Department is through the City telephone switchboard where only one telephone number serves all City agencies including the police. A separate police-only telephone number will be installed for emergency calls. Three telephone lines to three operator positions within the police department will be installed. These three positions in the order of daytime answering priority will be:

- The desk sergeant position
- The radio dispatch position
- The telephone switchboard

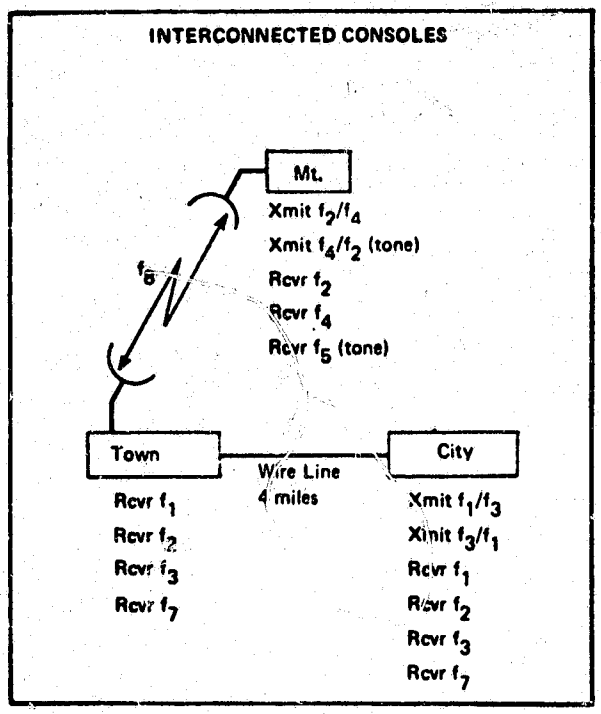
The telephone number 555-1234 has been made available for this service and telephone company personnel will install the new system. The system is scheduled for operation by the first of November and will be preceeded by an advertising program using all media components to acquaint the public with the new police emergency number in Old City. This advertising program will be conducted by the telephone company as part of their Public-Service Information program.

(2) Radio Subsystem

Approval has been given by the Town Council of Good Town and the City Council of Old City to implement a system that consists of interconnecting duplicate control consoles at the City and Town police departments giving each agency access to the combined radio facilities of both departments. A symbolic diagram of the concept is shown in Figure 1A.

A summation of the radio equipment needed to implement the system is shown in Table 3A.

It will be necessary to modify the FCC radio station licenses for the mountain transmitter and the transmitters at City Hall. If the spare transmitter is retained at Good Town Municipal Building, its license can remain unaltered until it expires or is renewed.



FREQUENCY LEGEND

f_1 = City Police - Lo Band
f_2 = Township Police - Lo Band
f_3 = Local Tactical Freq. - Lo Band
f_4 = Mutual Aid - Lo Band

(Tone) = Tone controlled squelch encode or decode

f_5 = County Sheriff - Lo Band
f_6 = Surveillance - Hi Band
f_7 = Portable Transmit Only - Lo Band
f_8 = Microwave Link No. 1

FIGURE 1A
Interconnected Duplicate Control Consoles

Maintenance for the system equipment will continue as a contract service by the equipment manufacturer's franchised representatives. The retirement of older vacuum tube equipment from the inventory and its replacement by newly manufactured solid state equipment will have a favorable effect upon maintenance costs.

CONTINUED

3 OF 4

Table 3A
Equipmer' Source Summary

Mountain Site

Transmitter f_2/f_4	Existing Transmitter f_2
Transmitter f_4/f_2	Existing Spare City Transmitter f_1
Receiver f_2	Existing Receiver f_2
Receiver f_4	New Receiver
Receiver f_5	New Receiver
Microwave f_8	Existing Microwave - Add 3 Channels

Town Location

Dispatch Console	New Custom Design
Receiver f_1	New Receiver
Receiver f_2	Existing Receiver
Receiver f_3	New Receiver
Receiver f_7	New Receiver
Microwave f_8	Existing Microwave - Add 3 Channels
Mobile Radios - 4 Channels	3 needed for new cars
Portable Radios - 2 Channels $T\text{-}f_7/R\text{-}f_2$ - T/Rf_3	4 needed for new patrol

NOTE: Spare transmitter f_2 is over 25 years old and is retired from service as no longer needed as back-up to the mountain transmitter.

City Location

Dispatch Console	New Custom Design
Transmitter f_1/f_3	Existing Transmitter f_1
Transmitter f_3/f_1	New Dual Channel Transmitter
Receiver f_1	Existing Receiver
Receiver f_2	N New Receiver
Receiver f_3	New Receiver
Receiver f_7	Existing Receiver
Mobile Radios - 4 Channels	29 needed for replacement
Portable Radios - 2 Channels Tf_7/Rf_1 - T/Rf_3	8 needed for replacement

NOTE: Surveillance frequency f_6 is portable-to-portable only but there is an existing monitor receiver at the City location.

Town and City

Telephone interconnect for consoles	New Installation
Moving and Rigging	Moving City Transmitter to Mountain

All of the equipments proposed for the new system are standard catalog items of the major manufacturers. No training expenses are anticipated in addition to the regular training of field personnel in the operation and care of their radio equipment. The two dispatch consoles will be constructed to special design specifications and dispatching personnel will require training in the proper operation of the consoles. This training will be conducted by the console supplier and its cost will be included in the cost of the purchasing contract.

(3) Interagency Coordination System

The interagency coordination system defines the operational use of the equipment system capabilities. It is planned that after the normal business day the radio console and the police emergency telephone lines for Good Town will be switched to the Old City radio dispatcher. All incoming calls and the dispatching of Good Town patrol units will be done by the Old City dispatcher. Good Town has agreed to compensate Old City for this service.

All police vehicles for both Good Town and Old City have identical four-channel radios with the following frequencies:

f_1 = Channel 1 = City Police operational frequency

f_2 = Channel 2 = Town Police operational frequency

f_3 = Channel 3 = Local tactical frequency

f_4 = Channel 4 = , County mutual aid frequency

Any combination or separation of mobile field units of both the City or the Town for operational or tactical purposes can be established from either console position using any of four radio channels.

The low-powered portable radios for both agencies have a separate talk-back frequency to prevent the higher-powered mobile transmitters from blocking out the portables on the operational frequencies. All field units, both portable and mobile, listen to the base station on the regular operational frequency and so are aware of other traffic on that channel. This dual-frequency channel on the portables is tuned to receive f_1 for City portables and f_2 for Town portables. All portables have the second channel tuned to transmit and receive on f_3, the local tactical frequency.

Communication with the County Police Mutual Aid Network is simplex on f_4 for any mobile or the mountain-top base station. The base station will always control the mutual-aid situation and will assign mobiles as the occasion demands.

Communication with the County Sheriff at the County Seat is point-to-point from the mountain transmitter. The Sheriff's receiver is guarded with a tone-controlled squelch which is activated at the transmitter when it is desired to call the Sheriff by radio on f_4, the Mutual Aid Channel. On return, the receiver that is tuned to the Sheriff's radio frequency f_5 is also guarded by a selective tone-controlled squelch so that only the Sheriff's call to the City or the Town will be monitored.

Communication with the State Highway Patrol will be indirect through the County Sheriff. The Sheriff's Department has established a cross band link with the State Highway Patrol. Through this link, the Sheriff's dispatcher will be able to relay traffic between the State Highway Patrol and the City or Town. However, the State Highway Patrol Substation does monitor the County Mutual Aid channel so that in the future an addition of a VHF high-band receiver on the Patrol frequency and located at the mountain top site will provide direct cross band communication.

5. SYSTEM FUNDING

Initial cost estimates for the implementation of the system total $113,164. This cost does not include the cost for a consulting engineer to complete the engineering design and for the costs of the planning service needed to procure the grant funds from Federal and state sources. The total of these services is not expected to exceed $27,000.

Operating expenses for the new radio communication system are estimated to be $91,157 a year as compared with the total of $120,966 that was expended last year to operate the separate Town and City police radio systems. The saving of $29,809 is the total of $11,046 expected to be saved by the City and $18,763 expected to be saved by the Town.

A detailed breakdown of each of these estimates is available in the program files at Old City Police Department Staff Services for the benefit of those persons with a need for more complete information.

Federal and state grant funds are anticipated as the source of engineering design and planning funds and also the procurement and installation funds. Application for a grant from LEAA through the SPA is being prepared. A preapplication for this grant has been filed with the SPA to assure compliance with the State Comprehensive Law Enforcement Plan. The equipment contribution from both police agencies is expected to provide a "soft" match to the Federal grant funds and a ruling on this has been requested from the LEAA regional office.

Annual operating costs for the new system will be derived from the annual operating budgets of the Old City Police Department and the Good Town Police Department. The estimates of operating costs indicate that annual cost savings of $11,046 for the City and $18,763 for the Town are probable.

The total of $140,164 for engineering, procurement, installation and test is scheduled to be committed within nine months from the start of the program in order to complete the system and place it into operation within two years. The full amount of the grant will have to be made available within nine months of the grant award.

6. IMPLEMENTATION PLAN

The system implementation will be directed by the following organizations and personnel. The officials of both Old City and Good Town have concurred in the designated responsibilities of these individuals and have agreed to their participation in the capacities shown below:

- *Program Director* – Lt. Fellow, Old City P.D.
- *Systems Design Engineers* – Consulting Contractor
- *Financial Control* – Old City Auditor
- *System Procurement* – Old City Purchasing Director
- *Local Licenses and Permits* – Good Town Attorney
- *FCC Licenses* – Consulting Contractor and Good Town Attorney
- *Facility Construction* – Old City Engineer
- *Power and Utilities* – Old City Engineer

- *System Interface Liaison* – Lt. Fellow, Old City P.D. Old City Engineer; Consulting Contractor

- *Maintenance Subsystem* – Annual Subcontract – Purchasing

- *Personnel and Training* – Good Town Personnel Director

- *Source Selection Board* – Lt. Fellow, Old City P.D. Consulting Contractor; Old City Purchasing Director; Good Town Purchasing Agency; Old City Attorney; Good Town Attorney

- *System Test* – Lt. Fellow, Old City P.D.; Consulting Contractor; Old City Engineer

- *System Evaluation Board* – Lt. Fellow, Old City P.D. Old City Public Safety Director; Good Town Public Safety Supervisor; Consulting Contractor

- *Operational Procedures* - Chief of Police Old City and Chief of Police, Good Town

The program schedule is based upon a two-year time interval after the grant is approved. The Project Implementation Schedule is shown in Figure 1A. All persons responsible for the activities listed above will prepare detailed implementation schedules of their areas of responsibility within 10 days of notification of grant award and submit these to the program director for approval. These task schedules will be based upon the project schedule of Figure 2A.

The following activities will begin upon notification by the Program Director:

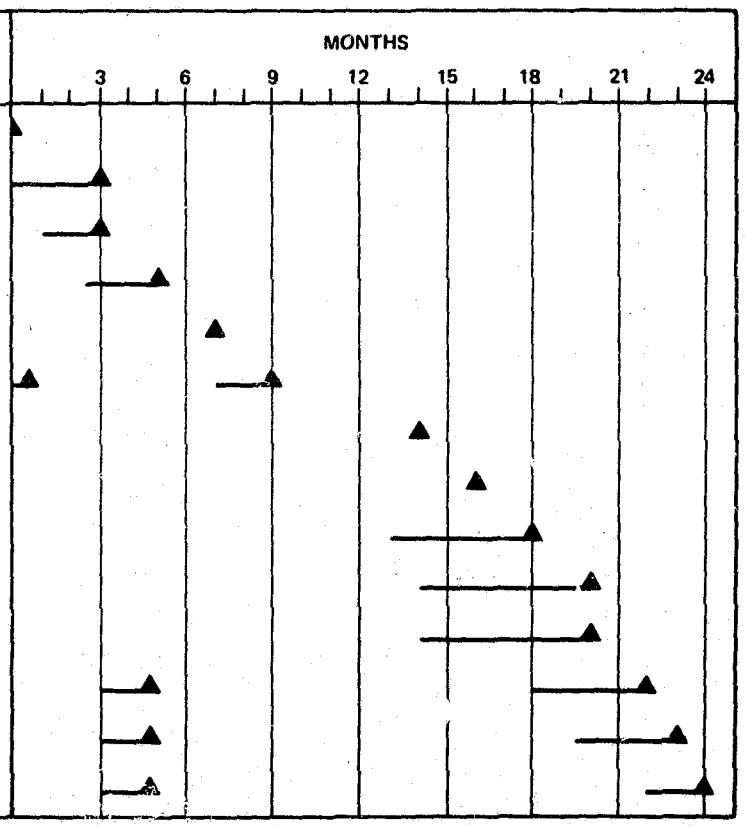
- *Program Director* – Review all task schedules; review and revise the Planning Document; review cost schedules and grant award funds; establish financial and performance control program

- *Source Selection Board* – Review unsolicited proposals from candidate systems consultants and select the consultant contractor

- *Consulting Contractor* – Review engineering data file; prepare wireline and radio control link characteristics; prepare system specification; prepare equipment specifications; confirm or modify traffic load and radio propagation analysis.

FIGURE 2A
Project Implementation Schedule

TASK AND MILESTONES	TASK RESPONSIBILITY
GRANT AWARD	PROGRAM DIRECTOR
ENGINEERING SPECIFICATIONS	CONSULTING CONTRACTOR
LICENSES AND PERMITS	TOWN ATTORNEY
ISSUE RFP	PURCHASING DIRECTOR
PROPOSALS DUE	PURCHASING DIRECTOR
CONTRACTORS SELECTED	SOURCE SELECTION BOARD
MOBILES AND PORTABLES DELIVERED	PURCHASING DIRECTOR
BASE STATION EQUIPMENT DELIVERED	PURCHASING DIRECTOR
BASE STATION SITE MODIFICATION	CITY ENGINEER
CONSOLES AND DISPATCH CENTERS COMPLETE	SYSTEM EVALUATION BOARD
TELEPHONE SYSTEM INSTALLED	SYSTEM EVALUATION BOARD
BASE STATION ACCEPTANCE TESTS	CITY ENGINEER
SYSTEM INTEGRATION TESTS	CITY ENGINEER
SYSTEM EVALUATION TESTS	SYSTEM EVALUATION BOARD



▲ DENOTES A MILESTONE AND IS A TASK COMPLETION POINT

The program director will review with the responsible task leader the progress and performance of each task area on a monthly basis. Changes in the planning that result from these reviews will be distributed in the form of a written advisory from the program director. The Planning Document will be revised and reissued every three months.

Financial control will be the responsibility of the Old City Auditor who will advise the program director at monthly intervals, or sooner if the need arises, as to financial performance and project progress. All funds will be disbursed from the office of the Auditor and no other person is authorized to spend or to commit project funds without specific and written authorization from the Auditor.

7. PROCUREMENT

The radio system will be procured through competitive bidding with known and reputable system contractors from a bidder's list prepared by the State Department of Telecommunications. A Request for Proposal (RFP) will be issued by the Old City Purchasing Department and will include:

- Specifications for all equipment performance parameters
- Specifications for all system performance parameters
- Specifications for all system interface parameters
- Specifications for system tests and acceptance tests
- Location for all system components
- Delineation of services to be provided by the system contractor such as installation, training, etc.
- Contractor responsibility for system tests and acceptance tests.

The authority for committing the Town and the City is vested in the Old City Purchasing Director by a resolution passed by the City Council of Old City and the Town Council of Good Town on August 29, 1975. A copy of this resolution is on file with the City Clerk and the Town Clerk.

The procurement task schedule prepared by the purchasing director and Submitted to the program director upon notification of grant award will include, but will not be limited to, the following milestone points:

- Date for establishing the bidder's List
- Date of the RFP distribution
- Date of bidders preprocurement briefing
- Proposal due date and time
- Proposal review dates and times
- Contractor award notification date
- Contract signing date.

All system tests and acceptance tests will be conducted according to specifications prepared by the System Design Engineer and made part of the RFP documentation. The tests will be evaluated by the previously named System Evaluation Board. The acceptance of the system and authority for the conveyance of title to the system is vested in the person of the Old City Purchasing Director who will be guided by the findings and the report of the System Evaluation Board.

8. POSTIMPLEMENTATION EVALUATION

The initial report of the System Evaluation Board will be made a part of the final issue of this Planning Document which will be distributed no later than 30 days after the date of system acceptance. The final issue of this Planning Document will be a permanent record of the program from concept to acceptance of the system.

Data logs of both telephone and radio traffic will be reported to the program director by both police agencies on a monthly basis. In addition, all maintenance and equipment down-time will be reported. One year from the date of system acceptance, the program director will issue a statistical report relative to the degree the system has improved citizen access, interagency coordination and reduced communications system operating expenses.

9. APPROVALS

In accordance with the resolution passed by the City Council of Old City and the Town Council of Good Town, it being duly recorded, we affix our seal and signatures:

Mayor, Old City

Mayor, Good Town

APPENDIX B

SAMPLE PLANNING DOCUMENT TOPICAL OUTLINE

APPENDIX B

SAMPLE PLANNING DOCUMENT TOPICAL OUTLINE

The following outline contains the basic elements of a telecommunications system planning document. Different programs may require additions and deletions. The size and detail of this document are a matter of judgement. In general, the minimum document that will serve the purpose is recommended. The main purpose of the plan is to ensure understanding of the program among the participants and to describe the program to all other affected agencies.

1. INTRODUCTION

This section of the document will describe the reason for the plan and the general method of proceeding.

- The authority for the plan will be stated and identified.
- The purpose of the document will be stated.
- The agencies included in the plan, or affected by the plan, will be identified.
- The need for the program will be delineated as will the factors leading up to the need.
- The problem the program is to solve will be identified and dimensioned.

2. DATA BASE NEEDS

This section of the document will list the data used to reach the conclusions or decisions contained in the plan and other data which may be needed.

- The need for a data base by the planner and the user will be defined.
- The agency or individuals responsible for developing the data base will be identified.

- The elements that make up the files of this particular data base will be identified.

- The methods of collecting the data, filing the data and providing access to the data will be discussed.

- The schedule for developing the data base will be specified.

3. PROJECT GOALS, OBJECTIVES AND REQUIREMENTS

This section will specify the goals to be supported by the plan. It will define the specific telecommunications objectives to be accomplished and will define the specific performance requirements that must be attained.

- The specific goals of the program will be defined.

- The relations between the program goals and broader statewide or national goals will be identified.

- The program objectives to be met in attaining the program goals will be defined.

- The program requirements to be met in the attainment of program objectives will be identified.

- Where applicable the concurrence with State Comprehensive Law Enforcement Plans and State Telecommunications Plans will be discussed.

4. THE SYSTEM CONCEPT

This section of the document will define the system that was chosen to be implemented.

- The overall system concept will be discussed in terms of overall functional capabilities including operational, technical, managerial and financial considerations.

- Interface needs, coordination considerations, human factor aspects and all other factors that bear on the final system should be explained.

- The system concept should be specific in terms of the number of radio frequencies required, licenses needed, the interfaces with other systems, the

definition of telephone or wireline subsystems, hardware capabilities required, software needs, maintenance philosophy, personnel requirements, training needs, disaster operations and operational procedures.

- Personnel and training needs will be discussed.

- System costs and cost savings will be evaluated.

5. SYSTEM FUNDING

This section of the planning document will define the sources of system funding and any restrictions or constraints that are placed upon that funding. It will identify implementation costs, planning costs, development costs, and operation costs. A schedule of funding requirements will be included.

6. IMPLEMENTATION PLAN

This section of the document will define the methodology by which the program will be implemented and assign overall implementation management responsibility.

- All tasks required to accomplish the implementation program, i.e., procurement, contract management, test and acceptance, etc. will be identified and the responsible agencies designated.

- Responsibility for supervision of the implementation plan will be designated.

- The program schedules for the accomplishment of each major task will be presented.

- All implementation interface activities such as real estate acquisition, utilities preparation, etc., must be specified and the responsibilities identified.

- The plan for reporting and control of performance and cost will be described and the authority for supervision of both will be established.

- The contents of the participation in and responsibility for the test, acceptance and evaluation program will be specified.

7. PROCUREMENT

This section of the document will establish the method of procurement, the procurement plans and the procurement schedules.

- The principal procurement policies and regulations applicable to the project should be cited.

- The agency responsible for preparing the procurement package, conducting source selection and providing contract supervision will be designated.

- Participation in the source selection board should be identified and the criteria to be used for source selection should be described.

- The type of procurement decided upon should be specified. The type of specification to be used, and the person or agency responsible for the preparation of these specifications should be identified.

- The schedule dates for preprocurement briefings, proposal due date, and contract awards will be part of the document.

- The contents of the procurement package in terms of contractor support or coordination, contractor responsibility for system interface, contractor responsibility for hardware, software and system performance will be designated.

- The criteria and dates for delivery, subsystem and system acceptance, the conveyance of title, and the agent responsible for acceptance will be specified.

8. POSTIMPLEMENTATION EVALUATION

This section of the document will describe the evaluation program needed to assess the degree to which the program met its objectives.

- The responsibility for developing and conducting the evaluation program will be shown and the participating personnel identified.

- The schedule for the program and the criteria by which the evaluation will be measured will be designated.

- The scope of the evaluation report and its distribution will be stated.

APPENDIX C

CONSOLIDATED CHECKLIST

APPENDIX C

CONSOLIDATED CHECKLIST

The following pages are a consolidation of the individual checklists that follow each chapter of these guidelines. They are consolidated here as an aid to the planner who would use them as a quick reference during the planning process.

CHECKLIST

II. THE PLANNING PROCESS

1. Has the type of plan been decided? ☐

   Long-range plan ____
   Short-range plan ____

2. Have all planning phases been completed? ☐

   Needs and problems are confirmed ____

   Objectives and requirements are established ____

   Planning assumptions are confirmed ____

   Alternative concepts are identified and evaluated ____

   Best alternative concept has been chosen ____

3. Have implementation plans been completed? ☐

   Project management needs defined ____

   Engineering management needs defined ____

   Procurement agency procedures defined ____

   Legal considerations and needs defined ____

4. Have post-implementation evaluation plans been completed? ☐

   Evaluation parameters defined ____

   Data base update plan completed ____

CHECKLIST

III. ESTABLISHING A DATA BASE

1. Does the data base include all major files? ☐

   Inventory files ____

   Management files ____

   Technical files ____

2. Are the Inventory Files complete (see Table 3)? ☐

3. Are the Management Files complete (see Table 4)? ☐

4. Are the Technical Files complete (see Table 5)? ☐

5. Has a methodology been established for data base management (see Section 2)? ☐

6. Have data collection methods been standardized (see Table 6)? ☐

7. Has the data base been complied for efficient retrieval (see Table 2)? ☐

8. Has a program been established to update and validate the data base (see page 30)? ☐

9. Have all existing data files been examined and all useful data extracted? ☐

CHECKLIST

IV. SETTING GOALS, OBJECTIVES AND REQUIREMENTS

1. Have public safety goals been identified and reviewed? ☐
2. Have all resources been used to identify objectives? ☐
   - Do objectives support the goals? ____
   - Has the data base been analyzed? ____
   - Have resource agencies been consulted (Table 8)? ____
   - Have state and national standards been used? ____
3. Have all resources been used to identify requirements? ☐
   - Do requirements support objectives? ____
   - Has the data base been used? ____
   - Have resource agencies been consulted (Table 8)? ____
4. Have requirements been used to identify tasks? ☐
5. Have the goals, objectives and requirements been documented and distributed for review? ☐
6. Has a program been implemented to review objectives and requirements periodically? ☐

CHECKLIST

V. SYSTEM CONSIDERATIONS

1. Have radio channel traffic loads been analyzed? ☐

   Is channel congestion a factor? ____

   Is a queueing analysis needed? ____

2. Have telephone line traffic loads been analyzed? ☐

   Are there sufficient emergency lines? ____

   Are there sufficient administrative lines? ____

   Is a queueing analysis needed? ____

3. Have the data system needs been analyzed? ☐

   Has the volume of digital traffic been established? ____

   Will facsimile be needed? ____

4. Have the system interfaces been analyzed? ☐

   Have information system interfaces been considered? ____

   Have public safety interfaces been considered? ____

   Has the interface with Civil Defense been considered? ____

   Have regional, state, and interstate coordination been considered? ____

   Have the man-machine interfaces been considered? ____

CHECKLIST

VI. DEVELOPING, EVALUATING AND SELECTING FROM ALTERNATIVE CONCEPTS

1. Have all resources been used to develop alternative concepts? ☐

   Have subsystem alternatives been developed? ____

   Have system users been consulted? ____

   Have similar systems been examined? ____

   Has the literature been searched? ____

2. Have the goals and objectives been used as an evaluation criteria for the alternatives? ☐

3. Has operational compatibility been used as an evaluation criteria? ☐

   Compatible with agency operations? ____

   Compatible with interagency coordination? ____

4. Has technical feasibility been used as an evaluation criteria for alternative concepts? ☐

   Uses available components? ____

   Are needed telephone trunks available? ____

   Is the propagation model feasible? ____

5. Has the cost of each alternative been an evaluation criteria? ☐

   Investment cost analysis complete? ____

   Operating cost analysis complete? ____

   Cost saving analysis complete? ____

   Cost-benefit analysis complete? ____

6. Have legal considerations been an evaluation criteria for each alternative? ☐

   Conformance with Federal regulations? ____

   Conformance with LEAA guidelines? ____

   Conformance with state law? ____

   Conformation with local ordinances? ____

7. Has the concurrence with other plans been considered in ...e evaluation of alternatives? ☐

   With state Comprehensive Law Enforcement Plan? ____

   With state telecommunications plan? ____

   With state standards and goals? ____

   With national standards and goals? ____

8. Has acceptability of the system been a criteria in evaluation? ☐

   Acceptable to the user agency? ____

   Acceptable to the community? ____

   Acceptable to local government? ____

CHECKLIST

VII. PROGRAM FUNDING

1. Have municipal funding needs been established and included in appropriate budget requests? ☐

2. Has application for State grant funds been made? ☐

3. Has application for Federal LEAA grand funds been made? ☐

4. Have all other sources of Federal funding assistance been explored? ☐

   Department of Defense ___

   Department of Labor ___

   Department of Health, Education and Welfare ___

   Department of Transportation ___

5. Have municipal bonds been considered as a source of funding for the project? ☐

CHECKLIST

VIII. SELECTING THE PROCUREMENT METHOD

1. Has a system function specification been prepared for system procurement? ☐

2. Have the needs of the system been analyzed to determine if a system performance specification is adequate for system procurement? ☐

3. Will system needs require the development of a detailed system specification for procurement? ☐

4. Can the system be procured by specifying the make and model number of the equipment? ☐

5. Is the system procurement specification compatible with the size and complexity of the system to be procured? ☐

CHECKLIST

IX. DEFINING THE ENVIRONMENT AND DEVELOPING FINAL SYSTEM DESIGN

1. Has the environment been fully identified and documented? ☐

   System environment ____

   Operational environment ____

2. Has the system configuration been documented? ☐

   All components and subsystems identified? ____

   Location of all components and subsystems defined? ____

   All communication links identified? ____

3. Have all new frequency and radio station license needs been identified and documented? ☐

4. Have radio license procedures been initiated? ☐

   Have available frequencies been located? ____

   Has the Frequency Coordinator been notified? ____

   Has a letter of intent been filed with the FCC? ____

   Is a special temporary authority needed to perform field tests prior to filing an application? ____

   Have the PS4-A forms been completed and filed? ____

   Have FCC license forms been acquired? ____

5. Have applications for all needed radio station licenses been filed with the FCC? ☐

   Has a Field Study Report been completed? ____

   Has all coordination been documented? ____

   APCO Frequency Coordinator ____

   Federal Aviation Administration ____

   U.S. Forestry Service ____

   Bureau of Land Management ____

   Occupational Safety and Health Administration ____

   Are Environmental Impact Statements filed? ____

   Have FCC license application forms been submitted with supporting documents? ____

   Has FCC follow-up action been planned? ____

6. Have all system interface characteristics been identified and documented? ☐

7. Have all equipment characteristics and specifications been identified and documented (Table 15)? ☐

8. Have equipment and system maintenance needs been established? ☐

9. Have all facility needs been identified and documented? ☐

   Dispatch centers and base stations ____

   Maintenance shops ____

   Repeaters and microwave stations ____

   Real estate and buildings ____

   Vehicles ____

10. Have system software needs been identified and documented? ☐

- Computer subsystem software ____
- Maintenance software ____
- Operating software ____
- Training software ____
- Installation software ____

11. Have all personnel needs been established? ☐

- Dispatchers and complaint operators ____
- Maintenance personnel ____
- Supporting and management staff ____

12. Have all levels of training needs been identified and documented? ☐

13. Have all levels of financial needs been identified and approved? ☐

- Acquisition costs ____
- Implementation costs ____
- Operating costs ____

CHECKLIST

X. PLANNING FOR IMPLEMENTATION

1. Has a program director been assigned? ☐

2. Has a work breakdown structure been developed? ☐

   Has the technical design function been identified? ____

   Has the program management function been identified? ____

   Has the purchasing function been identified? ____

   Are testing and evaluation functions identified? ____

3. Has a program schedule been documented and approved? ☐

   Is the project progress schedule complete? ____

   Is the project cost schedule complete? ____

4. Has the program management structure been established and documented? ☐

   Have authority and responsibility been defined? ____

   Have reporting and control functions been established? ____

5. Have project evaluation procedures been established, documented and implemented? ☐

CHECKLIST

XI. DEVELOPING PROCUREMENT SPECIFICATIONS

1. Are state level purchasing contracts available for the procurement of equipments? ☐

2. Do state or local agencies who traditionally buy telecommunications equipment have standard specifications available? ☐

   State Division of Telecommunications? ____

   State Police or Highway Patrol? ____

   State Highway Department? ____

   Large municipal police agencies? ____

3. Is a source of assistance available for the preparation of equipment procurement specifications? ☐

   From other state agencies? ____

   From outside contractor? ____

   From vendors and suppliers? ____

   From planning agency staff? ____

4. Have all elements been included in the specification document? ☐

   Is the introduction to the procurement needs complete? ____

   Are system and equipment performance parameters complete? ____

   Are specialized specifications for computer subsystems complete? ____

   Are facility needs specifications complete? ____

   Are system interface specifications complete? ____

   Are training specifications complete? ____

   Are documentation and manuals specific? ____

   Are test and acceptance specifications complete? ____

CHECKLIST

XII. PROCURING THE SYSTEM

1. Have all applicable Federal, state and local laws or regulations regarding the procurement of goods and services been considered? ☐

2. Has the method of initiating the procurement been established and documented? ☐

   Invitation for Bid ____

   Request for Proposal ____

   Sole-source procurement ____

3. Has a complete procurement package been prepared and distributed to potential offerors? ☐

   Has procurement been properly advertised? ____

   Are all standard clauses in the package (Table 18)? ____

   Are all standard items in the package (Table 19)? ____

   Has the purchasing authority been named? ____

4. Is a preprocurement conference needed? ☐

5. Has adequate time been scheduled to allow offerors to prepare a fully responsive bid or proposal? ☐

6. Has the proposal and bid evaluation been conducted in a routine and well documented manner? ☐

   Was preadvertised evaluation criteria followed? ____

   Were only responsive bids evaluated? ____

7. Were the preaward procedures conducted according to procurement regulations and well documented? ☐

   Were precontract award negotiations conducted? ____

   Were unsuccessful offerors properly notified? ____

   If there was no award, was the cancellation of the procurement initiated? ____

8. Was the award made on a sole-source basis? ☐

   Was grant agency approval obtained? ____

   Were all procurement regulations followed? ____

   Was the offeror's proposal evaluated and the evaluation documented? ____

   Was the offeror's price and performance negotiated and documented? ____

9. Was the procurement contract prepared by a recognized legal procuring authority? ☐

   What was the type of contract negotiated? ____

   Are all procurement guidelines reflected in the contract? ____

   Are the deliverables clearly defined? ____

   Is the schedule of performance well defined? ____

   Is the schedule of payments clearly defined? ____

   Is punitive clause clearly auditable? ____

CHECKLIST

XIII. POSTIMPLEMENTATION EVALUATION

1. Is there a formally documented postimplementation procedure and plan? ☐
2. Does the postimplementation evaluation plan relate directly to project goals and objectives? ☐
3. Has the responsibility for postimplementation evaluation been clearly assigned? ☐
4. Does the evaluation plan call for the collection of data during system test and acceptance? ☐
5. Has the evaluation plan included the measure of system effectiveness? ☐
   - Are planned organization roles carried out? ____
   - Is the system used as it was intended? ____
   - Is the system performing as planned? ____
6. Has the evaluation plan included the measure of technical performance? ☐
   - Does the equipment meet specification? ____
   - Does the reliability meet specification? ____
   - Is maintainability evaluated? ____
   - Is vendor support service evaluated? ____
7. Has the evaluation plan included the measure of financial performance? ☐
   - Is actual cost measured against budget? ____
   - Are financial controls and reports evaluated? ____
8. Has the evaluation plan included the measure of project management performance? ☐

9. Is adequate use made of all available data sources in the evaluation plan? ☐

Is the data base used? ____

Is performance test data used? ____

Is system test data used? ____

Is operation log data used? ____

Are comparisons made with other systems? ____

Are available statistical reports used? ____

APPENDIX D

GENERAL GUIDELINES FOR MAKING APPLICATION TO THE FEDERAL COMMUNICATIONS COMMISSION BY LAW ENFORCEMENT AGENCIES (LAND MOBILE)

APPENDIX D

GENERAL GUIDELINES* FOR MAKING APPLICATION TO THE FEDERAL COMMUNICATIONS COMMISSION BY LAW ENFORCEMENT AGENCIES (LAND MOBILE)

1. OTHER THAN IN THE CHICAGO REGIONAL AREA

Guidelines are presented here for applicants who are considered to be outside of the Chicago Regional Area for regulatory purposes. Applicants in the states of Illinois, Indiana, Iowa, Michigan, Ohio and Wisconsin should consult the companion guidelines, presented later in this Appendix, to determine which guidelines to follow.

(1) Determine System Requirements

Once the applicant has defined his communications requirements, he should determine how many stations, the classes of stations, how many frequencies and what power and antenna height are necessary to efficiently satisfy his requirements.

(2) Determine Compatibility with FCC Rules

With the system requirements defined, the applicant is responsible for seeing that the radio system and its use is consistent with the rules contained in the FCC Rules and Regulations before submitting applications to the Commission. The following are major items to consider before filing:

1. Eligibility

States, territories, possessions, counties, cities, towns, governmental subdivisions, and entities, including governmental institutions authorized by law to provide their own police protection, may be issued authorizations in the Police Radio Service or in the Local Government Radio Service.

*These guidelines do not apply to the 470-512 MHz band or the 900 MHz band.

2. Station Functions

Do stations function as those classes allowed on police service frequencies, if that service is used?

3. Frequencies Available

Lists of all frequencies available in the Police or Local Government Radio Services are contained in the rules. Assistance in selecting frequencies may be desired (See Item (3) following).

4. Frequency Justification

Are the number of frequencies justified? (Consider frequencies used in existing systems.) What are the functional uses for the requested frequencies? What is the spectrum environment in the area?

5. Power and Antenna Height

The amount of power and antenna height requested may be no more than is necessary for adequate operation of the system.

6. Modifications

For existing stations, the following modifications require an application for a new license:

- Increase in power
- Relocation of station
- Change in area of operation
- Increase in antenna height
- Change in RF frequency
- Any change which exceeds the terms of the license.

7. Environmental Considerations

An environmental impact statement may be required if new antenna towers exceed 300 feet or are located in a designated wilderness area or wildlife

preserve; affect sites significant in American history, architecture, archaeology or culture; affect areas of scenic or recreational value; or would involve extensive change in surface features.

8. Station on Government Land

If a station is installed or constructed on land under the jurisdiction of the U.S. Forest Service or the Bureau of Land Management, additional coordination with the Bureau is required and a statement showing compliance with the rules must accompany the application.

9. Rules for Control, Mobile Relay and Repeater Stations

Generally, mobile relays must transmit on base station frequencies. Control stations normally operate on the same frequency as the associated mobile units; however, there are special provisions in the rules that allow control stations to use other frequencies and to control other types of stations. The rules generally require licensees to employ directional antennas and carefully controlled powers at control stations.

10. Shared Facilities

If proposed operation involves shared use of another licensee's or applicant's facilities, the applicant should have an appropriate statement or cooperative use agreement drawn up and authenticated for filing with the Commission as an attachment to the application.

11. Non-Type Accepted Transmitters

If the applicant intends to use non-type accepted equipment, he must accompany application with a description of the equipment.

12. Non-Voice Emissions

Use of non-voice emissions such as telemetry, facsimile, vehicle locators, data transmissions, etc. may not be permitted on the desired frequency. A description of such use should accompany the application.

13. **Geographical Assignment Plan Frequency**

If the proposed system involves an areawide or regionalized operation, has a frequency plan been developed and filed with the FCC? Has coordination been effected with adjoining states or areas where appropriate?

(3) **Frequency Coordination**

The Rules require that applications requesting new stations or frequencies, addition of a station to an existing system or modification of existing facilities (See Item B.6.) be accompanied by evidence of frequency coordination. An applicant may submit one of the following to meet FCC frequency coordination requirements:

1. **Field Study Report**

A report based on a field study indicating the degree of probable interference to existing co-channel and adjacent channel stations. A temporary authorization may be granted to conduct an on-the-air interference study.

2. **APCO Frequency Recommendation**

A statement from the Associated Public Safety Communications Officers, Inc. (APCO) Area Frequency Advisory Coordinator recommending the specific frequency that, in the opinion of the coordination committee, will result in the least amount of interference to existing stations operating in the particular area. The committee's recommendations may appropriately include comments on technical factors such as power, antenna height and gain, terrain and other factors such as power, antenna height and gain, terrain and other factors which may serve to mitigate any contemplated interference.

It should be noted that a frequency advisory committee recommendation cannot be considered as a grant or authorization for any frequency. Neither the committee recommendation nor the field study report can be considered as binding upon either the applicant or the FCC. *The FCC makes the final determination as to whether or not use of the frequency is to be approved.*

Also, the FCC initiates further coordination with Canada where the proposed station is north of Line A (a line running parallel to and approximately 75 miles from the Canadian border). This may mean several weeks delay in processing the application or, possibly, a denial of the grant due to probable interference to Canadian operations.

(4) Where to File

All applications completed in accordance with the guidelines contained herein should be mailed to:

Federal Communications Commission
Washington, D.C. 20554

2. IN THE CHICAGO REGIONAL AREA

The guidelines set forth herein are applicable to the entire Chicago Region except for frequency coordination requirements which are delineated in Part C. The Region consists of all the counties within 175 miles of the center of downtown Chicago, Illinois (list follows). In addition, there is an area within the Region defined as the Chicago District. The District consists of all counties within approximately 100 miles of Chicago and these counties are listed in the attached Public Notice. For the purpose of this publication, those counties within the Region but outside the District are defined as the Regional Buffer Zone.

The Chicago Regional Office offers advisory services to planners and individual applicants. A professional staff of legal and engineering personnel can advise applicants as to interpretation and applications of the FCC Rules and Regulations, acceptable maximum limitations on radio systems, and spectrum resources available to meet the user needs. In addition, Chicago's computerized data base can be of use to the planner in determining possible interference problems, compatibility of usages, and statistical frequency usage (as opposed to number of mobiles).

The Commission will provide guidance to ensure that each plan conforms to its rules. Where a plan in on file, an effort will be made to ensure that applications for that area are consistent with the plan. Each application must be considered on its own merits at the time of filing, however, and the Commission cannot guarantee that any detail of a plan will be an acceptable basis for licensing.

(1) Determine System Requirements

Once applicant has defined his communications requirements, he should determine how many stations, the classes of stations, how many frequencies and what power and antenna height are necessary to efficiently satisfy his requirements.

CHICAGO REGION

The Chicago Region is defined to consist of the counties listed below:

ILLINOIS

1. Boone
*2. Bureau
*3. Carroll
*4. Champaign
*5. Christian
*6. Clark
*7. Coles
8. Cook
*9. Cumberland
10. De Kalb
*11. De Witt
*12. Douglas
13. Du Page
*14. Edgar
15. Ford
*16. Fulton
17. Grundy
*18. Henry
19. Iroquois
*20. Jo Daviess
21. Kane
22. Kankakee
23. Kendall
*24. Knox
25. Lake
26. La Salle
27. Lee
28. Livingston
*29. Logan
*30. Macon
*31. Marshall
*32. Mason
33. McHenry
*34. McLean
*35. Menard
*36. Mercer
*37. Moultrie
38. Ogle
*39. Peoria
*40. Piatt
41. Putnam
*42. Rock Island
*43. Sangamon
*44. Shelby
*45. Stark
*46. Stephenson
*47. Tazewell
*48. Vermilion
*49. Warren
*50. Whiteside
51. Will
52. Winnebago
*53. Woodford

IOWA

*1. Cedar
*2. Clinton
*3. Dubuque
*4. Jackson
*5. Jones
*5. Jones
*6. Muscatine
*7. Scott

MICHIGAN

1. Allegan
*2. Barry
3. Berrien
*4. Branch
*5. Calhoun
6. Cass
*7. Clinton
*8. Eaton
*9. Hillsdale
*10. Ingham
*11. Ionia
*12. Jackson
*13. Kalamazoo
*14. Kent
*15. Lake
*16. Mason
*17. Mecosta
*18. Montcalm
*19. Muskegon
*20. Newaygo
*21. Oceana
*22. Ottawa
*23. St. Joseph
24. Van Buren

OHIO

*1. Defiance
*2. Mercer
*3. Paulding
*4. Van Wert
*5. Williams

INDIANA

*1. Adams
*2. Allen
3. Benton
*4. Blackford
*5. Boone
6. Carroll
7. Cass
*8. Clay
*9. Clinton
*10. De Kalb
*11. Delaware
12. Elkhart
*13. Fountain
14. Fulton
*15. Grant
*16. Hamilton
*17. Hancock
*18. Hendricks
*19. Henry
*20. Howard
*21. Huntington
22. Jasper
*23. Jay
24. Kosciusko
25. Lake
*26. LaGrange
27. La Porte
*28. Madison
*29. Marion
30. Marshall
*31. Miami
*32. Montgomery
*33. Morgan
34. Newton
*35. Noble
*36. Owen
*37. Parke
38. Porter
39. Pulaski
*40. Putnam
*41. Randolph
42. St. Joseph
43. Starke
*44. Steuben
*45. Tippecanoe
*46. Tipton
*47. Vermillion
*48. Vigo
*49. Wabash
*50. Warren
*51. Wells
*52. White
*53. Whitley

WISCONSIN

*1. Adams
*2. Brown
*3. Calumet
*4. Columbia
*5. Dane
*6. Dodge
*7. Door
*8. Fond du Lac
*9. Grant
*10. Green
*11. Green Lake
*12. Iowa
13. Jefferson
*14. Juneau
15. Kenosha
*16. Kewaunee
*17. Lafayette
*18. Manitowoc
*19. Marquette
20. Miwaukee
*21. Outagamie
*22. Ozaukee
23. Racine
*24. Richland
25. Rock
*26. Sauk
*27. Sheboygan
28. Walworth
*29. Washington
30. Waukesha
*31. Waupaca
*32. Waushara
*33. Winnebago

*Counties in Buffer Zone.

NOTE: Applicants in the states of Illinois, Indiana, Iowa, Michigan, Ohio and Wisconsin having system located outside the counties listed should consult the companion item for guidelines to follow.

(2) Determine Compatibility with FCC Rules

With the system requirements defined, the applicant is responsible for seeing that the radio system and its use is consistent with the rules contained in the FCC Rules and Regulations before submitting applications to the Commission. The following are major items to consider before filing:

1. Eligibility

States, territories, possessions, counties, cities, towns, governmental subdivisions and entities, including governmental institutions authorized by law to provide their own police protection, may be issued authorizations in the Police Radio Service or in the Local Government Radio Service.

2. Station Functions

Do stations function as those classes allowed on Police Service frequencies, if that service is used?

3. Frequencies Available

Lists of all frequencies available in the Police or Local Government Radio Services are contained in the Rules. Assistance in selecting frequencies may be desired (See Item (3) following).

4. Frequency Justification

Are the number of frequencies justified? (Consider frequencies used in existing systems.) What are the functional uses for the requested frequencies? What is the spectrum environment in the area?

5. Power and Antenna Height

The amount of power and antenna height requested may be no more than is necessary for adequate operation of the system.

6. Modifications

For existing stations, the following modifications require an application for a new license:

- Increase in power
- Relocation of station
- Change in area of operation
- Increase in antenna height
- Change in RF frequency
- Any change which exceeds the terms of the license.

7. Environmental Considerations

An environmental impact statement may be required if new antenna towers exceed 300 feet or are located in a designated wilderness area or wildlife preserve; affect sites significant in American history, architecture, archaeology or culture; affect areas of scenic or recreational value; or would involve extensive change in surface features.

8. Station on Government Land

If a station is installed or constructed on land under the jurisdiction of the U.S. Forest Service or the Bureau of Land Management, additional coordination with the Bureau is required and a statement showing compliance with the Rules must accompany the application.

9. Rules for Control, Mobile Relay and Repeater Stations

Generally, mobile relays must transmit on base station frequencies. Control stations normally operate on the same frequency as the associated mobile units; however, there are special provisions in the rules that allow control stations to use other frequencies and to control type of stations other than mobile relays. The rules generally require licensees to employ directional antennas and carefully controlled powers at control stations.

10. Shared Facilities

If proposed operation involves shared use of another licensee's or applicant's facilities, the applicant should have an appropriate statement or cooperative use agreement drawn up and authenticated for filing with the Commission as an attachment to the application.

11. Non-Type Accepted Transmitters

If the applicant intends to use non-type accepted equipment, he must accompany his application with a description of the equipment.

12. Non-Voice Emissions

Use of non-voice emissions such as telemetry, facsimile, vehicle locators, data transmission, etc., may not be permitted on the desired frequency. A description of such use should accompany the application.

13. Geographical Assessment Plan Frequency

If the proposed system involves an areawide or regionalized operation, has a frequency plan been developed and filed with the FCC? Has coordination been effected with adjoining states or areas, where appropriate?

(3) Frequency Coordination

The rules require that, for applications requesting authorization for new or modified facilities, the existing environment of co-channel and adjacent channel stations be considered in the selection and assignment of a particular frequency. In the Chicago Region, the frequency coordination process is accomplished in two different ways depending on whether the applicant's station is located in the Chicago District or the Regional Buffer Zone.

1. Frequency Coordination for the Chicago District

The FCC Chicago Regional Center recommends and approves frequency selections for the Chicago District.

2. Frequency Coordination for the Regional Buffer Zone

An applicant whose station is located in the Buffer Zone, outside the District but inside the Region, may submit one of the following to meet FCC frequency coordination requirements:

- *Field Study Report* – A report based on a field study indicating the degree of probable interference to existing co-channel and adjacent channel stations. A temporary authorization may be granted to conduct an on-the-air interference study.

- *APCO Frequency Recommendation* – A statement from the APCO Area Frequency Advisory Coordinator recommending the specific frequency which in the opinion of the coordination committee will result in the least amount of interference to existing stations operating in the particular area. The committee's recommendations may appropriately include comments on technical factors such as power, antenna height and gain, terrain and other factors which may serve to mitigate any contemplated interference.

It should be noted that a frequency advisory committee recommendation cannot be considered as a grant or authorization for any radio frequency. The APCO recommendation or the field study report cannot be considered as binding upon either the applicant or the FCC. *The FCC makes the final determination as to whether or not use of the frequency is to be approved.*

Also, the FCC initiates further coordination with Canada where the proposed station is north of Line A (a line running parallel to and approximately 75 miles from the Canadian border). This may mean several weeks delay in processing the application or possibly a denial of the grant due to probable interference to Canadian operations.

(4) Where to File

All applications completed in accordance with the guidelines contained herein should be mailed to:

Federal Communications Commission
Chicago Regional Center
Park Ridge, Illinois 60068

GLOSSARY

GLOSSARY

Antenna	A system of wires or electrical conductors employed for reception or transmission of radio waves. Specifically, a radiator which couples the transmission line or lead-in to space for transmission or reception of electromagnetic radio waves.
Antenna Structures	The term includes the radiating system, its supporting structures and any surmounting appertenances.
Assigned Frequency	The frequency appearing on a station authorization from which the carrier frequency may deviate by an amount not to exceed that permitted by the frequency tolerance.
Associated Public Safety Communications Officers (APCO)	A non-profit public safety radio users group composed of administrators and communications technical, operational and command personnel.
Base Station	A land station in the land mobile service carrying on a service with land mobile stations.
Bid	A response to a published Request for Bids or Request for Quotation in which full disclosure of the wanted goods or services is made by public advertisement and price alone is the determining factor for contract award.
Channel	The term channel may signify either a one-way path providing transmission in one direction only, or a two-way path providing transmission in two directions.
Control Station	An operational fixed station, the transmissions of which are used to control automatically the emissions or operation of another radio station at a specified location.

Criminal Justice Information System (CJIS)	A computerized data base containing files related to the needs of law enforcement, public safety, judicial and corrections components of the criminal justice system. Usually, the information system is responsive to the needs of regional, statewide or multistate users.
Data Base	A collection of basic and factual information organized for rapid search and retrieval.
Discount Factor	The multiplier derived from the discount rate used to discount future costs and benefits so as to arrive at their present value.
Discount Rate	The interest rate used to discount future costs and benefits so as to arrive at their present values.
Division of Communications	A division, department, bureau, office or coordinator within state government which has mandatory authority or which acts in an advisory capacity for law enforcement telecommunications planning for itself and others or only for others.
DOC	Division of Communications.
Facsimile	The transmission of graphic matter by wire or radio and its reproduction at terminal facilities.
Fixed Service	A service of radio communication between specified fixed points.
Fixed Station	A station in the fixed service.
Fixed Relay Station	An operational fixed station established for the automatic retransmission of radio communications received from either one or more fixed stations or from a combination of fixed and mobile stations and directed to a specified location.
Frequency Band	A continuous range of frequencies extending between two limiting frequencies.

Frequency Modulation	The form of modulation in which the instantaneous frequency of a sine wave carrier is caused to depart from the carrier frequency by an amount proportional to the instantaneous value of the modulating signal.
Goal	A statement of broad direction, general purpose, or intent. A goal is general and timeless and is not concerned with a particular achievement within a specified time period.
Harmful Interference	Any emission, radiation or induction which endangers the functioning of a radio navigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radio communication service operating in accordance with FCC Rules and Regulations.
Interface	A concept involving the specification of the interconnection between two equipments or systems. The specification includes the type, quantity and function of the interconnection circuits and the type and form of the signals to be interchanged via these circuits.
Land Mobile Service	A mobile service between base stations and land mobile stations, or between land mobile stations.
Land Station	A station in the mobile service not intended to be used while in motion.
Law Enforcement Assistance Administration (LEAA)	An administration under the United States Department of Justice established by the Omnibus Crime Control and Safe Streets Act of 1968.
Link	A channel or circuit designed to be connected in tandem with other channels or circuits.
Local Government Radio Service	A service of radio communication essential to official activities of states, possessions and territories, including counties, towns, cities, and similar governmental subdivisions.

Microwave	Radio waves in the frequency range of 1,000 megahertz and upward. Generally defines operations in the region where distributed-constant circuits enclosed by conducting boundaries are used instead of conventional lumped-constant circuit components.
Mobile Relay Station	A base station established for the automatic retransmission of mobile service communications which originate on the transmission frequency of the mobile stations and which are retransmitted on the receiving frequency of the mobile stations.
Mobile Repeater Station	A mobile station in the mobile service authorized to retransmit automatically on a mobile service frequency communications originated by hand-held mobile units or by other mobile or base stations directed to such hand-carried units.
Mobile Service	A service of radio communication between mobile and land stations, or between mobile stations.
Mobile Station	A station in the mobile service intended to be used while in motion or during halts at unspecified points.
Mobile Transmitter	A mobile transmitter is a radio transmitter designed for installation in a vessel, vehicle or aircraft and normally operated while in motion.
Objective	A desired accomplishment that can be measured within a given time frame and under specifiable conditions. The attainment of the objective advances a system toward a corresponding goal.
Police Radio Service	A public-safety service of radio communication essential to official police activities.
Portable	A portable transceiver which can be carried by a person and may or may not be operated while in motion.
Present Value	The discounting of dollar benefits which accrues in the future to enable a direct comparison with investments made in the present time. This discount rate is based upon the time value of money or interest rates over the time period of the investment.

Proposal	A written response to a Request for Proposal in which there is contained an offer to perform services and/or provide material according to previously provided specifications.
Purchasing Agency	The person possessing the legal authority to commit to contracts.
Repeater Station	An operational fixed station established for the automatic retransmission of radio communications received from any station in the Mobile Service.
Requirement	A desired accomplishment that is subordinate to an objective. A requirement is attainable within a specified and immediate time limit, is consistent with the time frame of the objective, and is clearly measurable.
Special Emergency Radio Service	A public-safety service of radio communication essential to the alleviation of an emergency endangering life or property.
State Planning Agency (SPA)	The State Law Enforcement Planning Agency, as established by the Omnibus Crime Control and Safe Streets Act of 1968.
Station Authorization	Any construction permit, license, or special temporary authorization issued by the Federal Communications Commission.
Sunk Cost	A cost which is irrevocably committed to a project; such costs have little if any bearing on current management decisions.
Task	The smallest increment of self-achievable work that is identifiable, assignable and measurable within an immediate time frame.
Telecommunications	Land mobile law enforcement voice and data communications systems including their dispatch, command and control facilities wherein the terminals of such systems are located. The term includes the interfaces of such systems with those of common carrier, wide-area criminal justice information and other public safety communication systems but not the total complex of these systems themselves.

Telemetry	The equipment for measuring a quantity such as speed or position and transmitting the result by radio or wireline to a distant station and there indicating or recording the quantity measured.
Terminal Value	The expected value of either existing facilities, or facilities not yet in being, at the end of their useful life.
Tone	Tone as applied to a selective signaling system is an audio or carrier frequency of controlled amplitude and frequency.
Tone Code	Tone Code specifies the character of the transmitted tone signal required to effect a particular selection.
Uncertainty	The absence of a basis for accurately predicting the occurrence of an event. In cost evaluation uncertainty is the absence of a basis for accurately predicting future cost levels.
Unsolicited Proposal	A written offer to perform services and/or provide material that was not preceded by a solicitation in the form of specifications or a Request for Proposal (RFP).
Work Breakdown Structure	The hierarchical breakdown of a program into its major subdivisions, to the components of the subdivisions, and to the tasks needed to complete each component.

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