DESIGN AND OPERATION OF POLICE COMMUNICATIONS SYSTEMS

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY

Roger W. Reinke

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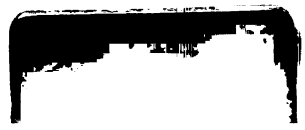

DESIGN AND OPERATION OF

POLICE COMMUNICATIONS SYSTEMS

by

Roger W. Reinke

AN ABSTRACT

Submitted to the
College of Social Science
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in partial fulfillment of the requirements
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APPROVED:

Raymond T. Galvin
Chairman

Lawrence J. Bard
Member

J. L. LaGrande
Member

ABSTRACT

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The need for communicating information between widely dispersed mobile units and the headquarters facility is well established in the police service. The most effective manner of accomplishing this information exchange depends to a large measure on individual requirements.

As a result, many varieties of communications systems are found in the police service. They are complex systems, and any attempt to measure their effectiveness must take into account all the factors which affect their operation. This research offers and verifies the hypothesis that application of sound management and technical practices permit communications systems to contribute substantially to accomplishment of the goals of the police agency.

The literature is reviewed and found to be restricted in its usefulness in terms of the study's objectives. Reliance is placed on personal study and analysis of several police communications systems.

The components of police communications systems are identified, and criteria for evaluation are evolved and tested in

case studies. The methods of communications most suitable for application in this field are noted.

The research permits some insight into the many approaches to design and operation which may be taken. It recognizes the limitations in consideration of one specialized field in the large area of communications technique.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

In accomplishing the goals of police service, regardless of local variation in police responsibilities, the need for communicating information has led to the development and application of specialized communications practices by police agencies. Because police departments are service oriented, the resources of personnel and equipment are directed in endeavors which for the most part involve timely and close contact with their clients at points throughout the jurisdiction. Without the capability to communicate effectively between field units and headquarters, the mobility required of the field force is unattainable.

The persons who come in contact with the police may be grouped into "willing" clients--complainants and those assisting the police in some way--and the clients who are the objects of police effort either in suppression of crime or in their apprehension after an unlawful act has been committed. Considering the first group, a law enforcement agency encourages the inward flow of information from it, in the form of calls for police service or as a source of other intelligence. Analysis is made of the information and action is taken based on what is known. The result is applied to persons in the latter

group--the persons who must be controlled if police responsibilities are to be met. The result may be directed towards events which do not involve persons, but things--situations which require police effort. The nature of this information process requires that it be performed as quickly as possible, because the security of life or property may be at stake.

There exists, then, a need to establish and maintain communications to insure an uninterrupted information input, and a corresponding information output to the units. This thesis describes how law enforcement agencies apply technical communications in achieving expeditious information flow; the construction of criteria useful in evaluating police communications systems; case studies applying the criteria developed; and literature available in the field of police communications.

The rapid changes brought about by development in the communications industry as a whole are always examined for their possible application in the police communication field. Many of the new techniques offer considerable promise, but most police agencies simply are unable to provide the support required for refinement and application.

Present day police communications are thus developed out of past experiences, and the experience of other "user" groups. There is also noticeable dependence on the approaches made available by

equipment manufacturers. To a degree, the manufacturers depend in turn on the needs and experiences of user groups such as the police in order to successfully market their products. However, the entire communications field is so large that any meaningful study must remain within the relatively narrow limits prescribed by known police requirements.

Therefore, although the actual means of accomplishing communications objectives may dramatically change, the objectives themselves remain, and the criteria for evaluation derived herein will remain useful.

I. STATEMENT OF THE PROBLEM

The purpose of this study is to: (1) identify the components of police communications systems; (2) determine the most effective methods of communicating police information; and (3) develop criteria to aid in evaluating communication effectiveness.

The key hypothesis is that by application of demonstrably sound management and technical practices, police communications systems will contribute substantially to accomplishment of the agency's objectives.

The practices described and developed herein are applied to test situations to determine their adequacy. Every system presents many individual characteristics, of course, but there are many more

common characteristics than unique ones. Identification and study of these characteristics permitted development of recommendations in the cases described, leading to implementation and subsequent review of their validity. Conclusions will be developed, after analysis of the test situations.

II. IMPORTANCE OF THE STUDY

The requirement for communications in police operations has been well established. The developments in the communications art, however, have not been matched with concomitant gains in many police applications. The trend toward greater use of one-man patrol vehicles, for example, creates a demand on communications systems which, unless recognized and resolved, adversely affects line operations.

Weaknesses in the police communications system come to light in times of peak demand, when the facility may be needed most urgently. By proper evaluation and with the knowledge of workable solutions, the police administrator is in a better position to realize maximum communications effectiveness. This study attempts to provide the administrator with the basic ingredients for sound communications decision-making.

III. SCOPE OF THE STUDY

This endeavor will be limited to researching the administrative and operational problems encountered in police communication systems, as well as the successful solutions which were developed in response. Particular items of equipment will not be examined beyond the use which may be made of the items in the total system.

The criteria for evaluation to be developed will be a result of the analysis of information gathered by personal study and observation. Particular case studies will be presented in order to test the hypothesis. The literature examined will be confined to published books and articles which directly bear on the topics under consideration.

IV. TERMS USED AND THEIR DEFINITIONS

The communications field is not without its share of convenient descriptors which facilitate the exchange of ideas among practitioners, but do nothing to illuminate terms for the general reader. A conscious effort is made to avoid these specialized words, and where their use is appropriate sufficient definition is afforded. The definitions of frequently used terms follow; they are based on the usage found in the police communications field, and the author's interpretation of that usage.

Land Line Systems. The sum of individual equipment interconnected by means of wire lines.

Radio System. The assemblage of individual communications devices interconnected by means of electromagnetic radiation; that is, the transmission and reception of radio waves.

Systems Design. The bringing together of all communications components to form a functional process meeting police communications requirements.

Frequency. A particular wave length in the radio spectrum to which appropriate radio system components are adjusted in order to intercommunicate. A "carrier" is transmitted on a specific frequency and serves as the medium to convey information.

Channel. A specific frequency (carrier plus normal bandwidth) or two frequencies always paired together, and allocated for a particular communications purpose.

Mobile Unit. A radio equipped vehicular conveyance or individual used in carrying out the mission of the agency.

Base Station. A fixed point from which radio messages are transmitted and received.

V. ORGANIZATION OF THE REMAINDER OF THE STUDY

The remainder of this research is apportioned among nine additional chapters, as follows:

Chapter II lists the basic requirements of both land line and radio communications systems. Miscellaneous requirements are also noted.

Chapter III describes the administrative and supervisory control required by these systems.

Chapter IV discusses the design of land line systems.

Chapter V is devoted to the design of radio systems.

Chapter VI describes federal regulations affecting police communications systems.

Chapter VII presents criteria for evaluating system designs, and the case studies made.

Chapter VIII points out maintenance provisions which must be considered.

Chapter IX is concerned with the affects of centralized control on police communications.

Chapter X presents a summary of the research and development of conclusions.

VI. SOURCES OF INFORMATION

Information was gathered for this thesis by personal study of certain communications systems in the United States, and interviews with persons responsible for their operation. The studies were performed in some cases as a part of a department-wide survey and evaluation, requested by the department, in which the author participated.

A review of the literature pertaining to police communications was found to be severely limited. Where specific sources are used, appropriate credit is given.

The case studies described were selected because they present typical problems encountered by departments of all sizes. No claim is made that the approaches listed are the "best;" however, the evaluation and recommendations made in each case were felt to be the most appropriate for the department under study.

CHAPTER II

BASIC COMMUNICATIONS REQUIREMENTS

Police communication needs may be conveniently divided into land line, radio and miscellaneous categories. This chapter will examine the requirements in each category common to all systems.

I. LAND LINE REQUIREMENTS

Called-for police services generally involve a degree of urgency. The largest proportion of initial contacts with the persons an agency serves are by telephone, because it provides a rapid path of communication.[1] Of all incidents coming to the attention of police a comparatively small number are reported in person, through correspondence, or by personal encounter in the field by a member of the agency. In the latter event, the incident is usually reported in much the same manner as any other complaint, although the matter may have been resolved at least temporarily by the member.

The availability of a telephone to persons within most jurisdictions has increased in proportion to the "standard of living"

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[1]O. W. Wilson, Police Records (Chicago: Public Administration Service, 1951), p. 13.

in the United States, to the point that a telephone is usually within relatively easy access. Under favorable economic conditions, in urban areas particularly, the number of homes and businesses with telephone services approaches 80 per cent.[2] It should be expected, therefore, that most requests for police service will be received by telephone.[3]

Facilities must be provided to receive incoming calls and process them according to the type of request. These calls may be divided into calls for police service or calls concerning police business.

The first group of course is of primary importance. There must be an adequate number of incoming telephone trunk lines to reduce as much as possible occasions which will result in a "busy" signal when a call for police is placed. There must be sufficient personnel to answer incoming calls without delay. The number of incoming lines and personnel available to process calls, however, is usually based on superficial measures of message volume, without a proper accounting of the peak periods which occur.

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[2]U. S. Dept. of Commerce, Statistical Abstract of the United States: 1964 (Washington: Gov't Printing Office, 1964), p. 515.

[3]Charles S. James, A Frontier of Municipal Safety (Chicago Public Administration Service, 1955), p. 54.

The value in periodically assessing the resources of the agency in receiving and expeditiously processing calls is frequently overlooked.[4] The feelings of frustration generated by receiving a "busy" signal when police assistance is sought are considerable, and do nothing to further the department's relations with those it serves. Occasionally, a disaster or other event which becomes known to many persons in a short period of time places an unusual demand on incoming lines. Since the provision of facilities to handle the sudden influx of calls is economically impossible, other means to reduce the input must be found.

In some instances, incoming calls for police service may be directed to a central receiving or complaint processing point, to substations, or to specific individuals within the police organization. As the number of points to which these calls may be routed increases, control of reporting and complaint personnel supervision decreases.[5] It is desirable, therefore, to assign the task of receiving these calls to a specific organizational unit, and to require that all such calls for service be rerouted, if necessary, to it. Even in large jurisdictions,

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[4]V. A. Leonard, Police Organization and Management (Brooklyn: The Foundation Press, Inc., 1951), p. 270.

[5]O. W. Wilson, Police Administration (New York: McGraw-Hill Book Company, Inc., 1963), p. 410.

the benefits gained by centralized control of complaint processing justifies the apparent high costs of facilities to link remote reporting points.

In order to insure maximum control and speed of processing, without delaying service by rerouting or relaying information, "emergency" numbers may be provided for summoning aid.[6] Emergency numbers terminate at a central point where adequate facilities and personnel are available to complete the complaint-dispatch procedure.

The second group of calls, of the non-emergency or business category, may be segregated from the first group by intercepting at a common switchboard or by providing an "administrative" number in the same manner as the "emergency" number. The effectiveness of this approach depends to some extent on informing the citizens of the choice. The capability of transferring calls from one group to another without requiring the caller to redial should be provided.

Direct lines from the central telephone exchange facilities should be installed to enable telephone company operators to contact complaint operators and vice versa without resorting to use of regular dialing procedure. These lines are justified for two reasons: to provide a direct path for relay of calls for assistance directed to

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[6]Municipal Police Administration (Chicago: International City Managers' Association, 1961), p. 362.

telephone operators from persons who then fail to complete the call, and to provide additional capability in the event of deliberate "jamming" of incoming trunk lines to further a criminal objective.

Attention should also be given to the adequacy of land lines used by the department in placing calls. Procedures should be established to administratively control long distance calls. Installation of telephones by-passing the department switchboard may be justified for placing and receiving calls of a more confidential nature, but supervision over the use of these must be established. Criminal investigation, vice control, and inspectional services would normally be the only organizational units requiring this facility.

The need for establishing and maintaining department-owned land line facilities of the call-box type has been diminished by the greatly increased availability of outdoor public telephones. Local policy may dictate retention of such private systems, but the reduction in the number of beats patrolled by officers on foot, combined with the availability of outdoor telephones and/or personal radio equipment, have influenced many cities to abandon privately-owned systems.[7]

It may be possible to salvage an outdated private call-box system in part and replace it with a combined emergency reporting

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[7]Ibid, p. 362.

system for police and fire services. Local telephone companies may provide this installation under a lease-maintenance agreement.[8]

Other land line requirements may include teletype facilities to augment radio links between departments or units of a department. Teletype networks relieve the load of non-emergency messages usually transmitted by radio or mail. If teletype facilities are needed to process the volume of messages originated and received, the department may participate in a network restricted to other area agencies or as a unit of the national public teletype system.

II. RADIO REQUIREMENTS

Fortunately, the state of the art of radio communications has eliminated the practice of broadcasting dispatches "in the blind," to mobile units which had no reliable means to acknowledge receipt or initiate their own messages. The primary requirement, therefore, of two-way radio capability between the control point and mobiles is now accepted and met. "Mobiles" also includes officers on foot, since refinement of two-way equipment makes available practical personal radio communications.[9]

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[8]Ibid., p. 366.

[9]The Police Yearbook: 1964 (Washington: International Association of Chiefs of Police, 1964), p. 25.

Expanded use of automotive equipment brings about the need in larger systems to divide or apportion message traffic. A single dispatching channel becomes insufficient to process the volume involved. When this need is anticipated or becomes apparent, several methods are available to achieve expanded capability requirements without seriously impairing system control.

A high level reliability is also demanded of communications between separate jurisdictions. Message exchanges between police departments are usually identified as intersystem communications, and may consist of nothing more than the monitoring of one system by the other, and vice versa ("cross monitoring"). Regardless of the particular approach, the need for regional intercommunication has received emphasis as civil defense requirements evolve, as the number of suburban departments maintaining independent systems increases, and as the benefits of information exchange in matters of mutual interest become recognized.[10]

III. MISCELLANEOUS REQUIREMENTS

Land line and radio communications are vulnerable to several phenomena which affect their reliability. The most important

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[10]Bruce Smith, Police Systems in the United States (New York: Harper & Brothers, 1960), p. 292.

provision which must be made is for alternate methods of communication (or simply duplicate equipment) and a continuing source of electrical power in the event of failure of normal power. Fortunately, this may be readily accomplished at small expense (in terms of total system cost) at each critical location of system components. The times when normal power becomes unavailable usually coincide with increased demands for police service.

There is also need to provide for and maintain the security of complaint processing and dispatching facilities. The importance of a communications center in departmental operations is recognized, and it is a prime target for attack by a hostile group of any type.[11]

The final basic requirement concerns a means of auditing and accounting for communications operations. This involves some sort of record of requests received by the police and their disposition.[12] The incoming request for police service is normally the first notification to the agency that a situation demanding its attention exists, and therefore the document or other form of record generated at this time may serve as a control over all subsequent action by the agency.

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[11]Wilson, Police Administration, p. 434.

[12]Ibid., p. 394.

CHAPTER III

ADMINISTRATIVE AND SUPERVISORY CONTROL OF COMMUNICATIONS SYSTEMS

The place of the communications unit in the agency, or in some cases outside the agency, the organization of the unit itself, its supervision and its staffing are discussed in this chapter.

I. ORGANIZATIONAL PLACEMENT

Considerable variation occurs in the placement of communications responsibilities in police organizations. Typically, communications are thought of as a supporting service to all line units, and therefore the persons fulfilling communications duties are assigned to a staff section.[1] Occasionally, a line unit such as the patrol division also operates the communications system, on the basis that it is the largest "user" of the service. In smaller departments, overall communications responsibility may be found assigned to a knowledgeable individual who performs this duty in addition to his primary task in some other function.

The expanded use in larger jurisdictions of radio communications by other municipal departments has led in some cases to the creation of a

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[1]Wilson, Police Records, p. 13.

centralized agency providing communications services to its users.[2] The centralized agency obviously relieves the police department of many of the administrative details involved, particularly in the technical phases. There remains, however, even in this kind of organizational approach, the need for establishing department control of the communications concerning police operations. The ramifications of centralized systems will be the subject of another section.

A step taken by many local governments, short of an autonomous communications agency, is to assign to the police department responsibility for communications services in all city agencies. This approach is usually an outgrowth of the police department's having the first and largest system in the local government, and therefore seemingly in the best position to provide a comprehensive service.

In this regard, the regulations of the Federal Communications Commission (FCC)[3] tend to segregate the various "public safety" services such as police, fire, highway maintenance, etc., so that a police channel, for example, is not overloaded with radio traffic of

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[2]Federal Communications Commission, Public Notice: Discontinuance of Fire Communications in the Police Radio Service, March 26, 1962.

[3]Section 89.3, 28 F.R. 14099 (1963).

other users in time of critical need. This prohibits the dispatching of other departments' units on a police frequency.[4]

In order to satisfy the needs of jurisdictions with a variety of communications demands, some of which could not afford to provide separate systems, the FCC created the "Local Government Service" which enables a government entity to carry on communications for all or a portion of its departments on a common channel.[5] Thus a police department may still share a radio system with the fire department, etc.; or, any combination of separate services in addition to "Local Government" may be authorized.

The police agency in smaller jurisdictions may find itself providing at least dispatching services for these other city departments as a result of the "Local Government" allocations. The other departments operate their own control points for the radio system during normal business hours, then turn over "off-hour" dispatching tasks to the police department because it is frequently the only agency operating around the clock.

Demands of this type may place a heavy burden on police communications organization. These demands are generated from

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[4]Section 89.305, 28 F. R. 14112 (1963).

[5]Section 89.253, 28 F.R. 14111 (1963).

without the Department, and usually unaccompanied by appropriate budget support or assignment of personnel to handle increased workloads. In a system with relatively light message volume even at peak periods, the additional dispatching tasks may be easily accommodated; a means of establishing a point at which efficiency of communications may be jeopardized is needed, however. Along with the need for measurement, the administration of the jurisdiction must recognize the intra-department aspects of this approach and clearly assign administrative responsibility.[6]

II. UNIT ORGANIZATION

The organization of the communications unit itself presents some problems due to the nature of the personnel requirements for the routine complaint processing-dispatching function contrasted with the engineering-maintenance activity. If the department is responsible for its own maintenance of equipment--usually, but not always the case--the chief engineer or technician may be under the direction of the commanding officer of the communications unit or he may occupy a comparatively independent position in recognition of his professional training. Alternately, the complaint processing function may be assigned to the "chief engineer."

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[6]Section 89.13, 28 F.R. 14100 (1963).

Viewed from the standpoint of the "communications system," organizational principles require that responsibility for both the technical and non-technical phases be identified and assigned beyond a simple designation of "staff" activities or individual recognition. The degree of specialization which appears inherent in the technical phase may justify separating this unit from other communications functions within the same division, but coordination and direction must still be afforded at a level below the chief administrator.[7]

In achieving unity of command, the following phases of the communications system are systematically brought together:

1. Receiving incoming complaints or calls for police service;
2. Generating a record of the request;
3. Dispatching appropriate units to dispose of the request;
4. Equipping the "action" agencies above with the means to carry out their duties.

A weakness in any of the segments above would obviously reduce operational effectiveness. The possibility of completely divorcing from police supervision one or more of these steps, on the basis of

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[7]Wilson, Police Administration, p. 40.

greater economies (through centralized maintenance, for example) does not eliminate the need to assure that the operation is properly directed and controlled.

Based on the size and complexity of the police organization, a common pattern of assignment of communications responsibilities emerges. The complaint processing steps--1, 2, and 3 above--are more closely related to the activities of a police records unit than to any other service unit. A line unit is not performing its proper function if it must allocate a proportion of its personnel to the service function of communications. In addition, there is a natural tendency to develop a proprietary interest when a system is controlled by a line unit, to the detriment of service to other department activities.

The "service" connotation of communications in a staff position counters the narrow interest problem. The extensive use of records by complaint operators and dispatchers in the performance of their duties, in addition to their responsibility for originating important source documents, strongly favors placement in the records organization.[8]

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[8] Ibid., p. 57

The organizational patterns which seem to have enjoyed success in various-sized departments are depicted in Figure I to illustrate the considerations mentioned. The smallest departments, represented in "A," must rely on the desk officer to carry out communications tasks in addition to many other duties which arise during his tour of duty. As the size of the organization increases, the importance of proper handling of the complaint dispatching process is reflected in the number of personnel assigned to "specialties" and the concomitant degree of supervision which must be afforded. Illustrations "B," "C" and "D" in Figure I reflect this growth.

It will be noted that in each of the partial structures shown the complaint processing is centralized. This phase of communications must be so treated if control is to be achieved.[9] A possible exception, of course, is in a jurisdiction such as a state police agency where operations are conducted from substations. In this case, functional control still remains at headquarters, with what amounts to staff supervision performed in the field. The advent of private microwave or other "tie lines," however, enables even a centralized state-wide communications system to function much in the same manner as a municipal system. For example, the Michigan State

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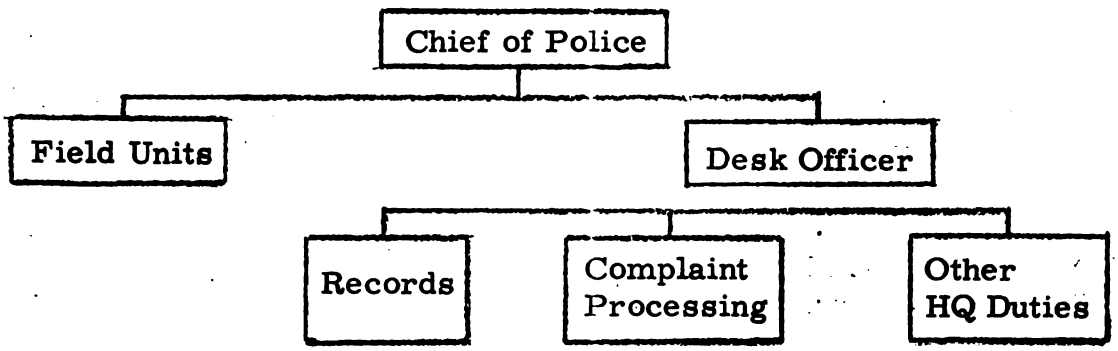
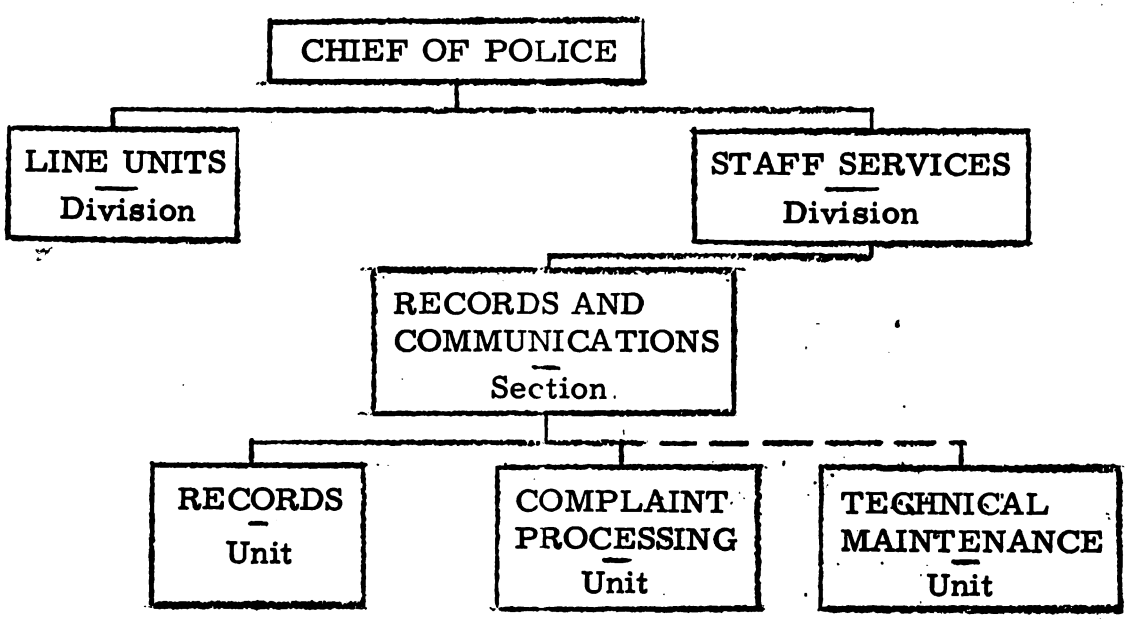
[9]V. A. Leonard, Police Communications Systems (Berkeley: University of California Press, 1938), p. 314.

FIGURE I

REPRESENTATIVE ORGANIZATION

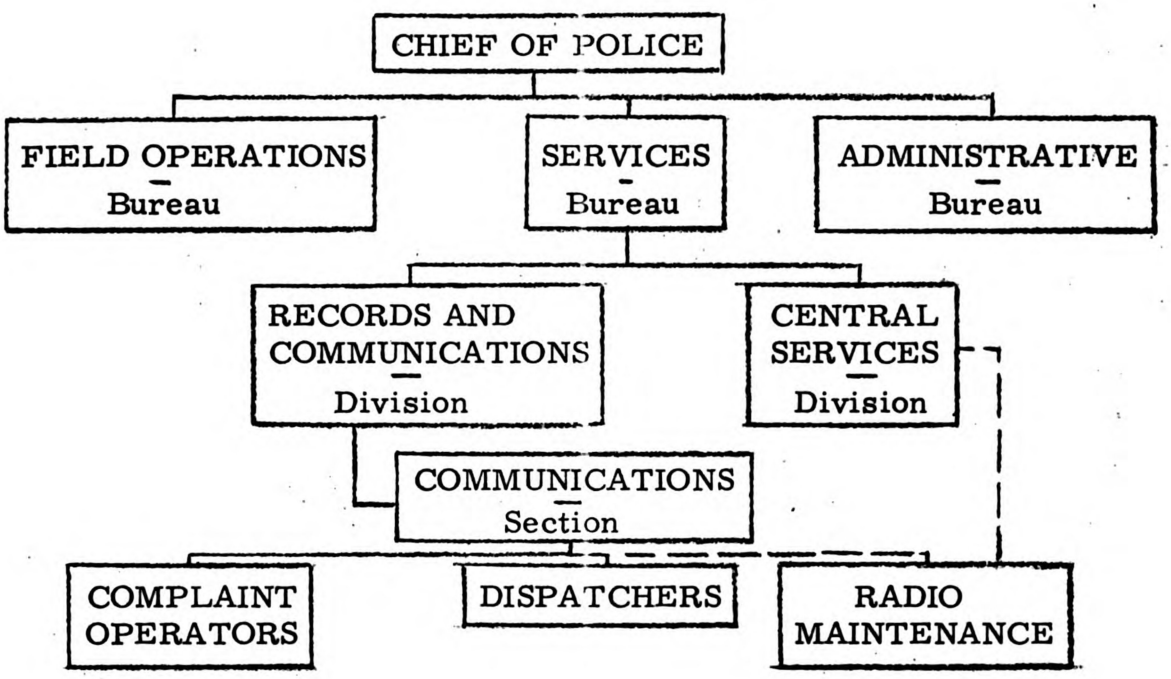


"A"

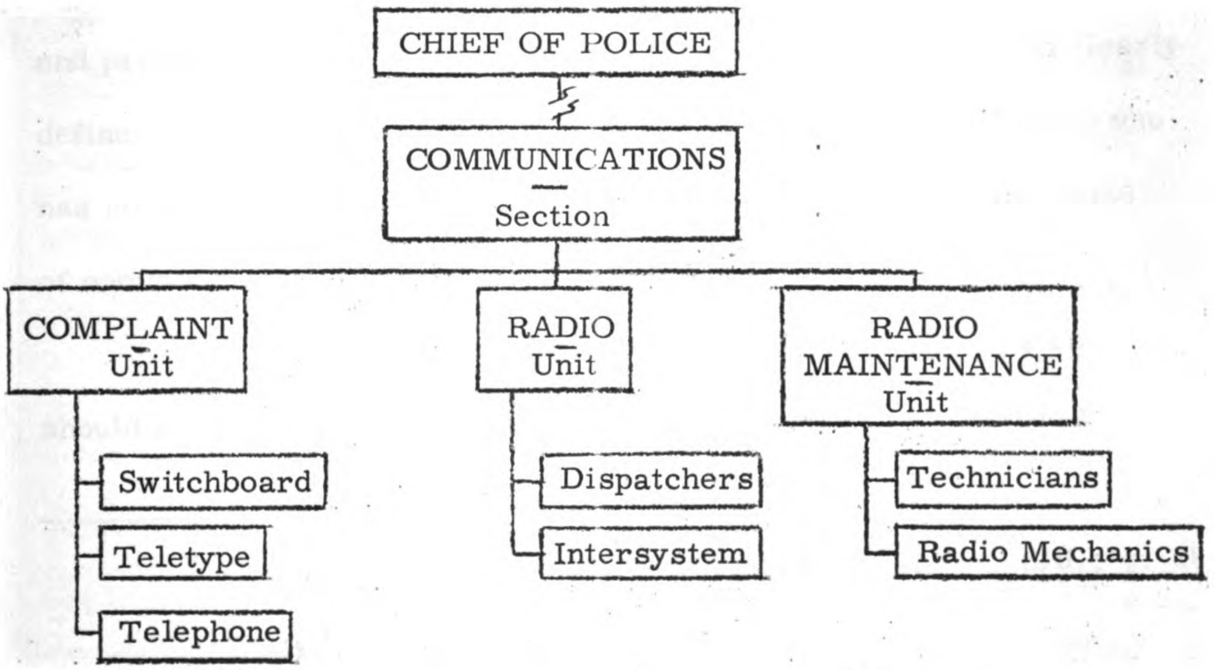


"B"

FIGURE I (continued)



"C"



"D"

Police describe the authority at headquarters as follows:

> The Post commanders and supervising operators at . . . (area headquarters) exercise general supervision over the operating personnel and maintenance of the radio quarters. All communications over the radio system are entirely under the supervision of the Communications Bureau at East Lansing.[10]

III. UNIT SUPERVISION

The level of authority required by dispatchers in the performance of their duties is sometimes assessed erroneously. Although the position demands skills not possessed by every member of the department, there is no demonstrable need for supervisory or command rank if the dispatcher, regardless of rank or civilian status, acts as the "voice" of the commander in that his orders are so recognized by regulation and proper supervision is afforded at all times. O. W. Wilson clearly defined this "staff command" as "the giving of orders by an agent who has no authority in his own right but who performs the routine tasks of command as a service for his principal."

The task of supervising a police communications system should not pose any unusual problems arising out of the nature of

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[10]Communications Manual, Michigan State Police, n.d., p. 18.

[11]Wilson, Police Administration, p. 50.

the task. The fact that it is a centralized operation somewhat eases supervisory needs in comparison to supervision in the field.

This is not to say, however, that adequate supervision may be accomplished by assigning responsibility to any supervisor who happens to spend the majority of his tour in the headquarters facility. The sensitive nature of the process demands at least constant availability of supervision, if not by virtue of the number of personnel assigned.

The designation of a field supervisor to also act as a supervisor for communications, if other headquarters supervisors are available, deprives personnel of guidance in times of emergency situations when it is needed most. A sergeant on patrol, for example, cannot comprehend the entire current deployment pattern and assess needs from his isolated position in the field. Once at the scene, the sergeant would be expected to assume responsibility for tactical deployment.

Supervisory responsibility must be assigned to assure that directives are followed during all times of the day. Functional supervision will remain with the records-communications supervisor, but in smaller departments (or widely dispersed substations) staff authority should be provided in the absence of the regular functional supervision. [12]

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[12] Ibid., p. 79.

This staff authority is most often found in the patrol unit, since it is on duty during the entire day. The extent of the supervision exercised by the patrol unit should be clearly understood--that the methods used or the nature of the tasks performed by the service unit of communications remain a responsibility of that commander. The patrol supervisor would be expected to correct any violations of regulations and generally assure himself that proper attention is given to the tasks assigned by the records-communications commander.

Duties of a communications supervisor typically center around the coordination of operating positions. In smaller agencies, he may perform the dispatching task during his tour of duty; in any sized agency he is expected to assume an active role in handling unusual situations, and he is responsible for proper notification of superior officers.

A particularly sensitive aspect of the communications supervisor's job is to assure that complaints against department personnel are received and forwarded to the appropriate internal investigating unit or, if a complaint is directed against a subordinate, that the proper steps are followed in accordance with departmental directives. A substantial proportion of complaints of this type are brought to the attention of the department by telephone, and, unless

procedures are specified, the administration may not learn of these allegations in a timely manner, if ever.

In larger installations, provision should be made for the supervisor to monitor both land line and radio communications as they are carried on. Performance of complaint operators and dispatchers may thus be evaluated to determine training needs, and to correct improper procedures. A monitoring position is also useful in instruction of newly-assigned personnel.

IV. STAFFING

Processing of calls for police service is a task in police operations carried out at headquarters usually involving only the rather impersonal contact with the public afforded by the telephone. Although some knowledge of criminal law is required of persons assigned as complaint operators, no direct enforcement action is expected of them. There is nothing inherent in the task, therefore, that necessarily justifies the assignment of sworn personnel to processing complaints.

The trend toward greater utilization of civilian personnel in law enforcement agencies results in a proportionate increase of

civilians in communications work.[13] The increase is accounted for by the responses of police administrators to manpower allocations which force the assignment of sworn personnel to tasks which must be performed by them. Their civilian replacements, usually in the "desk job" category, may oftentimes be employed at lower salary rates, which of course is an incentive to seek additional tasks performable by them.

The greatest concern of police administrators in contemplating use of civilian employees in communications work is that "non-police" personnel will fail to understand the complexities of the police job, and will make unsatisfactory decisions even in routine processing of complaints. This is often expressed in terms of the failure of civilians to adequately screen out "unimportant" or "nuisance" calls. A clearly expressed policy of what types of calls are to be answered by assignment of officers, however, may be implemented by either sworn or civilian personnel.

The experience of police agencies which have assigned civilian employees to this type of work shows general acceptance and satisfaction particularly where careful selection and training

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[13]A. C. Germann, Police Personnel Management (Springfield: Charles C Thomas, 1958), p. 158

is provided.[14] The contention that the resulting investment in a civilian employee voids any monetary savings over use of sworn personnel is answered at least in part by civilian job satisfaction demonstrated in low turnover rates.[15]

Most police officers appear to prefer the kinds of assignments which include work in the field. The practice of assigning injured officers who are restricted to "light duty" tasks to communications work frequently results in personal dissatisfaction, as expressed in their attitudes in dealing with the public and fellow workers.

Where sworn manpower is felt justified and available, a tangible incentive is sometimes required to assure job satisfaction, and therefore acceptable levels of performance. The city of Chicago, for example, adds $50 per month to the salary of qualifying complaint operator/dispatchers who are patrolmen, in order to maintain a well-motivated staff. The turnover of sworn personnel in this case is quite low, and a substantial "waiting list" results.[16]

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[14]O. W. Wilson, Police Planning (Springfield: Charles C Thomas, 1952), p. 232.

[15]Personal Interview, Captain Charles O'Connor, Dade County Public Safety Department, January, 1963.

[16]Personal Interview, Captain W. L. Miller, Chicago Police Department, December, 1963.

In a 1960 survey of state law enforcement agencies, five of the 48 respondents indicated exclusive use of sworn radio dispatchers, and eleven a combination of both sworn and civilian employees. The balance, 32 agencies, relied entirely on civilians.[17]

Municipal agencies, at least at the time of this writing, do not use civilian employees exclusively to the extent found in their state counterparts. The practice generally followed is to assign civilians to complaint taking, and sworn personnel to actual dispatching of field units. This approach is applicable to agencies which experience a volume of work justifying separate complaint operator and dispatcher positions, of course. In the smaller agencies, civilian employees who have been well-trained in police records work, departmental regulations, and who have been indoctrinated in and observed field patrol practices, are entirely capable of acting as combination complaint operator-dispatchers.

The use of women employees in dispatching tasks is criticized by some on the basis that they become too emotionally involved in stress situations. Officers in the field, it is held, are reluctant

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[17] Comparative Data (State and Provincial Section of the International Association of Chiefs of Police, 1960), p. 6.

to place the degree of reliance that must be placed on any dispatcher on women especially in a one-man patrol operation. The experience of at least two large dispatching organizations--the Los Angeles, California, Police Department, and the Dade County, Florida, Department of Public Safety--indicates that carefully selected and trained women are fully capable of performing this task. In Los Angeles, female dispatchers are considered to become less emotionally involved in demanding situations than men, and enjoy greater success in correcting or advising field units than do men.

It is apparent that selection is important for any phase of communication work, whether assigned to civilian or sworn personnel. The ability to remain calm and effective in times of stress is not readily measurable by any economical "paper and pencil" test, nor is the ability to evaluate the status and deployment of field units and make rapid--and correct--dispatching decisions.[19]

The selection responsibility is oftentimes out of the hands of the police administrator if civilian employees are contemplated,

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[18]Personal Interview, Emmet L. Jones, Los Angeles Police Department, July, 1964.

[19]Richard H. Blum, (ed.), Police Selection (Springfield: Charles C Thomas, 1964), p. 100.

the positions involved falling under the jurisdiction of the local civil service agency. However, job descriptions should be developed and the personnel agency should welcome any suggested criteria which will help to define and classify the tasks at hand. A prospective employee should be given the opportunity to view the communications center in action; the experience may save subsequent processing steps if the applicant cannot relate personal abilities with requirements.

The selection of supervisors for communications tasks requires the abilities which would be expected in any police supervisory position, with emphasis on analytical and decision-making abilities. The unexpected demands caused by an event requiring extensive headquarters direction must be met if the situation is to be controlled, and the services of command personnel may not always be available. Rotating field supervisors through the communications position increases their comprehension of the total police operation, and may serve as a screening device to select officers for regular assignment who demonstrate their potential in this capacity.

CHAPTER IV

LAND LINE SYSTEM DESIGNS

The communications process may be thought of as starting with the notice to the police agency that a situation exists requiring its attention. The manner in which an agency receives a notice of complaints and initiates action is described in this chapter, as well as a summary of complaint processing components, the combined complaint operator-dispatcher, participation in the process by supervisors, and department owned facilities.

I. COMPLAINT PROCESSING

Incoming calls for police service, or those requiring the complaint processing agency to take some kind of action, are received from external (citizens and other departments) and internal (inter-agency) sources. Of the latter, calls may be received from units within headquarters and substations, or from field units. Calls may be of varying degrees of urgency, but all require those who receive calls to make some disposition in response.

Because of this funneling of communications through a central processor, the degree of efficiency in handling calls becomes important in contributing to the successful operation of

the agency. As has been noted, the position of the complaint processing unit lends itself well to control responsibilities, to assure that all calls received from whatever source are properly disposed of.

This control is accomplished by serially numbering complaints as they are received. Calls for police service from outside sources constitute the largest proportion of all calls received, and because the police agency is maintained to serve the public, merit first attention.[1] Some notation must be made at the time the call is received to indicate its source and nature, the date and time of receipt, and the action taken. By such notation, the agency may:

1. Establish measures of workload;
2. Provide a source document which determines and guides the input of related reports;
3. Record details of handling in case of subsequent inquiry.

A control number assigned to each notation of a complaint received provides the means for matching related reports, and may also indicate type of complaint, etc., for internal filing purposes. In situations involving many complaint operators, one operator or

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[1]Wilson, Police Administration, p. 384.

position is assigned the responsibility of maintaining control records. It is not necessary that strict chronological numbering be followed, but that all complaints to which a unit is assigned be accounted for. Note that the recording of complaints does not mean an item-by-item entry in a log of all radio transmissions.

Recording equipment to make available actual telephone conversations for supervisory or investigative purposes is a useful addition to the control of complaint processing. It may also be used to quickly verify uncertain details of a complaint, especially if the complainant cannot be recontacted. Recorders should be considered as auxiliary equipment, however, and not in lieu of generating a written record of calls for police service at the time they are received.

The investment in recording equipment may be substantial, but it is not necessary to provide a channel for each incoming or outgoing telephone trunk line if the recorder is connected across each complaint operator's headset or handset. Thus, conversation may be recorded regardless of telephone trunk line selection.

A question frequently arises about imposing an audible tone or "beep" signal on incoming lines to indicate that the conversation is being recorded. This is required by, and contained in, the tariffs filed by telephone companies with the FCC and state utility commissions.

It is argued by some police administrators that the effect of the "beep" signal deters a complainant or informant from communicating adequate information and/or personal identification.

Service by the local telephone company may be denied if it is found that its tariffs are being violated. The current tariff reference is quoted in the following statement:

> Pursuant to the requirements of the Commission's Orders, the various telephone companies have since filed with the Commission tariff schedules permitting the use of recording devices in connection with interstate and foreign message toll telephone service, subject to the condition that "connection of customer-owned voice recording equipment with the facilities of the Telephone Company shall be made only through recorder-connector equipment which contains a recorder tone device automatically producing a distinctive recorder tone that is repeated at intervals of approximately fifteen seconds when the recorder equipment is in use. Permanent connection shall be made only through recorder-connector equipment furnished, installed and maintained by the Telephone Company." It is the Commission's understanding that similar tariff regulations applicable to the use of recording devices in connection with local and intrastate telephone service have been filed by the telephone companies with respective state regulatory commissions.
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> . . .It should be noted that under the provisions of the Communications Act of 1934, as amended, (47 U.S.C. §151 ff.), and Section 203 (47 U.S.C. §203) thereof in particular, the tariff schedules filed with the Commission by the telephone companies are binding upon those companies and the public, unless and until they are set aside as unlawful by this Commission or a court of competent jurisdiction. Accordingly, failure to use recording devices in

> compliance with the requirements of such tariff provisions may subject the user to appropriate enforcement proceedings provided in Section 401 and 411 of the Communications Act (47 U.S.C. §401 and 411), as well as termination of his service by the telephone company.[2]

The number of incoming telephone trunks to the complaint processing unit depends on the volume of incoming calls. A practical approach is usually taken in determining the number of trunks needed to accomplish calls; when repeated instances of all lines "busy" occur, then additional trunks may be added. It is not uncommon to find four or more lines per complaint operator, however, in spite of the obvious inability of one operator to process more than one or two calls at any one time.

The importance of identifying peak traffic periods and providing some means of relief is emphasized by the breakdowns which occur when the system cannot meet demands. Complaint operators may fail to record accurate and sufficient information; persons calling for police service may receive "busy" signals or be told to "hold;" and the number of field-originated requests

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[2]Federal Communications Commission, Public Notice: 60591, March 28, 1951.

channeled through complaint operators, in proportion to calls received, contributes further to the problem.[3]

A reasonable approach in determining the volume of calls each complaint operator may be expected to process is to request the local telephone company to count incoming calls each hour of each day of the week. The department may then determine average duration of each call by sampling, and establish a desirable maximum "waiting time" (no more than 15 seconds) before a call is answered. The incoming volume peaks at certain hours in each shift, so calculations should be made on a shift basis.

The data available, then, are average duration per call, maximum time before answer, and the hourly input during peak periods per shift. To the average duration per call of, say, 75 seconds, a "buffer" of 30 seconds should be added, since calls do not occur in an orderly sequence. A period of 60 to 75 seconds should be added to permit the complaint operator to "recover"--to complete recording of data or make notifications, etc. This total of 180 seconds (75 + 30 + 75) indicates that the operator should be able to readily process 20 calls per hour. If peak volume is 60 calls

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[3]Leonard, Police Communications Systems, p. 53.

per hour, three complaint operators would be indicated, and five incoming trunk lines exclusive of dispatcher's and intercom lines should be adequate to handle the load.

The tendency of calls for police service to peak at certain hours within each shift and period creates a personnel usage problem in communications, as it does in deploying field forces to gain maximum effectiveness. Since the workload of communications personnel corresponds to that of field forces, workload measurement in beat layout, for example, may be useful in anticipating days and hours of maximum demand. An exception might be found during the regular business hours, when non-emergency calls add to the calls for police received; however, this may be disregarded if an administrative or non-emergency number is offered.

Rather than assign personnel on a regular basis during the evening shift, which usually produces the largest volume of calls during the 24-hour day, equipment should be installed to permit taking of "overflow" calls by employees temporarily borrowed if necessary from records or other headquarters staff activities. Equipping an extra complaint operator position, located proximate to regular positions, is more economical than regular staffing of an additional position used only to partial capacity.

Supplementing at least one direct line to the telephone company central office, direct lines to other departments or agencies may be justified when the volume and/or urgency of contacts is significant--for example, between police and fire departments. Although a direct line enables immediate signalling of a call without dialing, the cost of the line if stations are widely separated may be prohibitive. The introduction of new pulse dialing techniques--by push button or prepunched cards, for example--reduces dialing time to the point that perhaps the only advantage of a direct line is to serve as an alternate if regular lines are occupied. Unfortunately, most direct lines are equally subject to outages as regular lines in severe storms, etc.

In an agency encompassing a large area, locations of incidents reported to police may be described inaccurately so that mobile units are misdirected. In a critical situation, the error could result in unnecessary loss of life. To assist complaint operators in establishing locations with maximum accuracy, means of identifying the general location of the source of calls may be valuable.

This may be accomplished by terminating incoming lines in groups according to the telephone exchange of origin. Incoming calls are then displayed at each complaint operator's position by location of the caller, and each operator may be assigned to as many groups (exchanges) as volume warrants. Other benefits include an additional

measure of workload according to exchange boundaries, and operator familiarity with persons and places in the areas (groups) to which he is usually assigned.

In this type of sorting of incoming calls, some will originate in one exchange but concern a matter in another; however, the actual emergency calls will almost always be found to originate within the exchange affected. The delineation of exchange boundaries will not coincide with existing beat or district boundaries created by the police agency, but no difficulties should arise if the complaint operators have a readily available means of verifying locations. A visible file, for example, may be placed at each operator position, listing streets, numbering, general area, and the beat responsible.

A means of intercommunicating between complaint operators and dispatchers or other departmental units is required. The most satisfactory method is by use of the same telephone equipment used for normal processing, since controls are readily accessible and flexibility is limited only by the type of telephone equipment installed at headquarters. The use of amplified intercoms, particularly between complaint operators and dispatchers, tends to interfere with radio traffic and contributes substantially to the inherent noise level found in any communications center.

In connection with the intercommunicating need, a means of alerting dispatchers (and supervisors) to an incoming call of high priority should be installed. Some means of indicating the telephone line involved is necessary so that the dispatcher may pass on information to field units as the conversation between caller and complaint operator is monitored.

A pneumatic tube system is sometimes installed in departments with scattered facilities, to permit a means of rapid transmission of documents among them. For example, records checks are occasionally conducted in this manner, with the dispatcher or complaint operator originating a request form which is transmitted to the records unit by tube. The form is then completed as appropriate and returned the same way. Although accuracy is enhanced, tube blockages, inattention by personnel to incoming carriers, and noise generated by the system, even when inactive, tend to outweigh the advantages.

The "Tel-autograph," a device which electrically and mechanically duplicates a message being written with special equipment at a remote location, is sometimes used to generate a record of calls for police service as well as to inform dispatchers of the details. The ability to write clearly with this device is needed, of course. The equipment is limited to applications involving a low volume of calls, unless a machine is installed for each operator. Because the written

record is contained on a continuous paper roll, filing is difficult, and times and dates must be manually noted.

If the volume of calls warrants a maximum of one or two complaint operators working with a single dispatcher, physical facilities should be designed to permit manual transfer of complaint memos between operators and dispatcher. As the staff increases in size, noise considerations and the size of desks prevent convenient grouping in this manner. In order to transport memos from a "stretched out" operator arrangement to dispatchers, a conveyor belt provides rapid transport and accessibility by as many operators as are needed.

Conveyor belts have the disadvantages of generating noise and, when angles must be negotiated, a tendency to jam. The general acceptance of belts, however, has led to improved noise control and anti-jamming features.

II. SUMMARY OF COMPONENTS

To summarize complaint operator aids needed to carry out the task, the following groups of equipment are required in one form or another:

1. Telephone answering devices--headsets and/or light-weight handsets, with associated line and selection "hold" controls.
2. Sufficient incoming trunk lines to handle peak loads; access to exclusive lines for outside calls; intercom and direct lines to other units or departments as needed; provision for transferring calls to other units.
3. Well designed forms upon which complaint information is noted; if available, automatic date-time stamping machines.
4. Means of transfer of original complaint document (preferably) between complaint operator and dispatcher, to reduce possibilities of error in recording information.
5. Automatic counters to provide message volume data (need not be located at the complaint operator's position).

III. COMBINED COMPLAINT OPERATOR-DISPATCHER

It should be apparent in the discussion of complaint processing thus far that the task may be treated as part of the dispatcher-desk officer function, such as that typically found in small departments operating independent communications systems. Complaint processing may require extensive specialization, perhaps with operators subdivided into geographical areas of responsibility. An alternate approach to the latter is to continue to combine the complaint operator's and dispatcher's duties in one position, and add personnel as message volume demands.

This would appear to offer some benefits. The combined operator/dispatcher takes the incoming call, and is in the best position to relay meaningful information to field units to respond to any questions from them concerning the complaint. Knowing the status of field units, the operator/dispatcher may be able to advise the complainants of any anticipated delay in response time, if the nature of the complaint so warrants. If a call of inquiry is received from command personnel regarding status or other information about a unit, the answer may be immediately available by checking status indicators or by radio contact.

Difficulties arise in this method, however, when the message volume would justify either a separate complaint operator and a

dispatcher or two combined operator/dispatchers (or any multiple thereof). The primary problem is the uncontrollable input of both telephone calls and radio traffic originated in the field. Telephone calls consistently require more operator time than do radio transmissions. The result is that an operator/dispatcher is frequently unable to respond promptly to radio traffic because of the comparatively lengthy process of extracting information from the complainant. Units in the field, of course, have no way of knowing that the operator is so occupied.

The second problem, and in some cases more limiting than the above, is the restricted number of radio channels available for dispatching purposes. Use of one or two channels by four or more such operator/dispatchers results in a coordination problem which outweighs the advantages otherwise gained. A competitive situation which cannot be readily resolved is found when message volume picks up, because priorities cannot be pre-determined until the complainant is interviewed. The solution is to provide additional dispatching channels (shared by fewer operator/dispatchers), but as will be seen, in many metropolitan areas frequencies are not available for this kind of expansion.

An example of this approach is found in the Chicago, Illinois, police radio system. The original concept was to divide the City into zones, complaints from which were to be processed by three operator/

dispatchers for each zone. An exclusive channel of communication with mobile units was assigned each zone. Each operator/dispatcher was provided with identical telephone and radio capability. The center (or primary) operator/dispatcher was to maintain current status of zone cars, and receive incoming radio traffic.

As the system began operation, it became apparent that the two secondary positions could not cope with the load of both complaint-taking and dispatching units when volume appreciably increased. The problem was coordination--but on a small scale. Fortunately, the flexibility of the design makes possible operation either by each position following through from complaint input to radio dispatch during light traffic periods, or by the two end positions transferring complaint memos to the primary dispatcher. In this case, the primary position handles all radio traffic for the zone, and an extra (fourth) complaint operator may be added to assist in telephone traffic.

IV. PARTICIPATION BY SUPERVISORS

In a system justifying the assignment of supervisory personnel for complaint dispatching operations only, the supervisor is sometimes used to review and distribute complaints to dispatchers. In this approach, all incoming complaints processed by complaint operators are routed to the supervisor, who may determine priority and/or the dispatcher who

completes the radio assignment of the mobile unit. Because the position is usually physically located between the two segments, the supervisor may readily assist wherever a problem occurs.

Some difficulties in this system arise when the volume of calls precludes expeditious handling by the supervisor, and backlogs result. In addition, the supervising function may suffer when full time is devoted to a task which in itself does not warrant supervisor's rank.

V. DEPARTMENT OWNED FACILITIES

A final consideration in complaint processing is the handling of communications received over department-owned or leased telephone facilities. In this category are also calls placed by the public over "emergency reporting systems."

The development of older call box systems was typically on an area or precinct basis, with the lines terminating at the precinct station. In many cities, still maintaining these systems, no public access to call boxes is afforded, and calls directed by members outside the precinct must either be relayed or made on a regular public telephone.

In localities making the private system available to the public, the proportion of calls received from boxes is quite small, generally, compared to that of regular telephone calls. There remains a need

to route the calls into central communications, however, because complaint control is equally applicable. Delays and occasional inaccuracies caused by manual relaying are additional justification for central termination.

"Emergency reporting" systems may be leased from telephone companies. Distinctively-marked boxes are installed at appropriate locations, calling attention to their use as either police or fire reporting points. In Miami, Florida, for example, a box is located at each traffic-signalized intersection. Because of fire insurance ratings, lines from these boxes most often are terminated in a switchboard located at the fire alarm headquarters. Thus, there may be manual relay of calls for police service required in this system also. The boxes may be equipped with an inconspicuous switch which permits employees to bypass the alarm switchboard, and be directly connected with the police facility.

Competition among suppliers of this kind of equipment is particularly keen, which if nothing else tends to make the costs of private system operation generally on a level with leased systems. The availability of maintenance should be considered in either system.

CHAPTER V

RADIO SYSTEM DESIGNS

The concluding phase of the communications process involves radio contact between the dispatcher and appropriate mobile units. This chapter examines the dispatching task, dispatching operations, intersystem operations, dispatching facilities, radio system groups, and other technical considerations.

I. THE DISPATCHING TASK

The processing of calls for police service up to the point of radio contact between the dispatcher and mobile units has been described. The dispatcher's task is to determine the kind and amount of manpower needed to resolve a request, select appropriate field units, and direct them in order to expeditiously dispose of it.

A good deal of decision making is inherent in the dispatcher's job from the standpoint of deployment alone. The resources available to him are a fixed amount of manpower in mobile units, assumedly located in known sectors of the jurisdiction. At any point in time, however, a proportion of these units may be out of service. Others may be manned by one officer requiring "back-up" by a unit from another sector on certain types of calls. Reserve strength must be

also kept in mind. Traffic and investigative units may require deployment services on the same basis as patrol units.

If the dispatcher is concerned with few mobile units, the decision making process is relatively simple, and time is likely available for the role of complaint operator as well. But there is a limit to the number of units which may be adequately directed and controlled by a single dispatcher, even with no responsibilities beyond deployment of units in accordance with complaint memos received. One radio engineer operating a complex system places this limit at 50 units.[1] The FCC, in allocating police radio channels, also uses this figure as a guide, but on the basis of channel loading rather than dispatching efficiency.[2]

The maximum number of units per dispatcher is determined by the message volume generated (the number and length of messages of both the dispatcher and his assigned mobiles). One channel may be shared by two or three dispatchers working as a team, although coordination problems arise when three or more are used.

A need arises for additional dispatchers and/or channels when complaints accumulate without broadcast, in spite of the availability

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[1]Personal Interview, Robert E. Brooking, Burbank, California, January, 1964.

[2]Personal Interview, John McCue, Federal Communications Commission, April, 1964.

of field units. More importantly, a new channel or revised dispatching is required when units or dispatchers find themselves in competition for air time during peak periods. The possibility of a missed call from a mobile unit asking for help, for example, must be avoided.

Quantitative measurements to project future demands on system dispatching operations are not always readily available. The number of field units and their types of assignments may vary, not always in proportion to workload. The raw number of incoming complaints may offer some guidance. Determination of actual transmitter time on each frequency used seems to aid in planning, in that as air time (as a proportion for an hour, for example) increases, less opportunity exists for dispatching and acknowledgment by mobiles. Since a dispatcher or a mobile unit may capture a channel at any point in time, some allowance must be made for the random occurrence.

II. DISPATCHING OPERATIONS

The concept of an individual completing both complaint reception and dispatching steps has appeal, but demands for police service in many communities result in expansion which may exceed one person's capabilities. As indicated above, several methods of apportioning the complaint processing-dispatching task are available. The objective here is to identify and describe the elements of police

dispatching systems. The combining of elements permits systems to be designed in accordance with local needs.

An initial step is to inventory the number and functional assignment of mobile units on duty each shift. In any department, units of the patrol and traffic divisions predominate, usually in the range of 50 to 80 per cent of field units.[3] The balance, composed of investigative, service and administrative units, represent a substantial proportion only during normal business hours. If the message volume generated by all units becomes excessive, it is necessary to divide mobile units into smaller groups and assign each group to separate channels.

As a second step, mobile units may be apportioned among dispatchers and/or channels by function, by geographical area of assignment, or by a combination of area and assignment. Thus, patrol and traffic units may share one channel, with investigative and all other units on another. Or, all units, regardless of function, normally assigned to one sector of the jurisdiction may be assigned a separate channel.

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[3]Total patrol and traffic division personnel (as a proportion of department strength) was found to be in this range in several departments studied by the writer. Units from these divisions are also more likely to spend almost all their duty hours in the field.

The possible combinations are many, but with each a problem arises in dispatcher coordination. For example, if two units are immediately needed at a scene of a police incident, a dispatcher may assign two units on his channel without knowledge of the location and availability of alternate channel units. In the case of assignment by area, a dispatcher may have to alert his counterpart handling the adjacent sector of incidents which could affect units near the boundary. The natural division afforded by a river, limited access roadways, etc., is generally favored over less obvious boundaries in this approach. In the Chicago Police Department system described earlier, telephone exchange areas prescribe zone boundaries; these are usually along streets.

The problem becomes more critical when events occur which cover a large area or require the attention of a variety of functional units. In order to maintain control in these situations, the following alternatives are available:

1. Each dispatcher may be equipped with controls to permit simultaneous broadcast on all affected channels, or
2. A mobile unit may be equipped with a channel selector to permit temporary communication on the alternate channel, or

3. All mobile units may be equipped with channel selectors to permit temporary communication on one common channel.[4]

The first alternative above provides additional flexibility, but coordination is hampered to a degree by the lack of knowledge of the status of units on the alternate channel. A supervisor is oftentimes assigned the task of making all-channel broadcasts, since he is theoretically in a better position to evaluate the resources available on each channel. The benefits of common status indicators available to, or visible from, each dispatching position are obvious in this case.

The other alternatives listed, involving frequency selection capability by mobiles, have an advantage in that during periods of light message volume, all may share a common channel controlled by one dispatcher.

The advantages gained by allocating mobile units to separate channels must be reconciled with the disadvantage mentioned of reducing information output on each channel. Department policy may

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[4]A fourth approach consists of installation of additional equipment in mobile units to permit simultaneous monitoring of more than one dispatching channel. The costs involved are substantial, and usually justifiable for supervisory and command personnel only. Operator fatigue is also a consideration in monitoring more than one channel.

specify that all calls of crimes in progress, for example, be either simultaneously broadcast or rebroadcast as soon as possible on all other channels. The disadvantage of group dispatching is more apparent in the routine message exchanges taking place between dispatchers and mobiles. In one-man car operations particularly, the feeling of teamwork is present. A natural concern arises over what situations are being encountered by adjacent beats, or by units from other divisions, if their radio traffic is conducted on another channel. No advance notice is available of a potentially hazardous situation; complete reliance must be placed on the dispatcher to obtain and relay the information needed.

Because the number of field units in larger systems simply cannot be accommodated on a single channel, the dispatcher becomes extremely important to the success of one-man patrol operation. He must evaluate all incoming complaints in terms of the minimum number of units required to handle the call. In single unit assignments, he must maintain mental surveillance to assure that the unit has not encountered unreported difficulty. If mobile-to-mobile communication is not provided, he must keep units advised of each other's activities which might require back-up, such as car stops and interrogation of suspicious subjects. He must pass on information of possible value to other dispatchers for broadcast to their units, and he must assure

that his units are promptly and completely informed of activities taking place which may involve them. There is no excuse for any police unit failing to take some indicated action when the unit is made aware of a situation, but declines on the basis that it is the responsibility of another division.

III. INTERSYSTEM OPERATIONS

A phase of dispatching operations worthy of note is the handling of intersystem communications. Most often, one dispatching position is equipped to monitor and communicate with other departments in the area by radio. The use of a shared frequency reserved for intersystem traffic offers the advantages of reducing the amount of traffic on regular dispatching channels, and smaller investment in receiving equipment if several other systems may be monitored on one receiver. A separate transmitter is usually required, however. Of consideration also is the attention demanded of a dispatcher if he must monitor the routine traffic of other stations in addition to his own. Operator fatigue may be further reduced on intersystem networks by installing selective calling equipment which mutes the dispatcher's speaker until his station is called.

The FCC has encouraged the use of area intersystem channels by allocating certain frequencies for this use.[5] With this incentive the number of departments participating in common networks is substantial, whether on local, state or interstate bases. They may be known locally as "the hot line," or "point-to-point," but all consist basically of a radio "party line."

The value of a rapid means of message exchange between jurisdictions is recognized in the state of California by the installation of a comparatively sophisticated intersystem network. The State is divided into four regions (ultimately five), each equipped with a control station and exclusive frequencies. If a station in one region wishes communication with a station in another region, the control station is contacted and sets up interconnection by means of dialing appropriate tones. The calling station then dials on its equipment the designator for the called station, and the message path is completed.

The terrain involved, while limiting range to some extent, does permit installation of automatic repeater stations at advantageous mountain-top sites. Thus, intersystem communications may take place

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[5]Section 89.309, 28 F.R. 14113 (1963).

without interference to other regions or without the necessity of manually relaying traffic between distant stations within the region.

With the availability of micro-wave links throughout the State, the network is made available not only to municipal and county law enforcement agencies, but also to the Department of Motor Vehicles and the California Highway Patrol. The versatility of the network has encouraged extensive participation by the smallest as well as larger agencies. An alternate point-to-point system is available in case of temporary outages through the Highway Patrol's Inter-Office Radio (IOR), which is simply a channel common to all headquarters and area offices of the Patrol.

As the number of users of an intersystem network increases, it is necessary to devise and implement standard rules of procedure. Terminology must be agreed upon, and especially acceptable message subject matter. Routine, non-emergency requests for motor vehicle or driver license data, for example, tend to defeat the purpose of an instantaneous means of communication between jurisdictions.

A means of intercommunicating police information over great distance is by use of radio telegraphy, or continuous wave telegraphy (CW). Starting in 1935 and continuing into the 1940's, many police communication engineers installed and staffed CW stations in their

departments, establishing a National Police Communications Network (NPCN).[6] Nine CW frequencies were allocated by the FCC zone and interzone communication.

In concept, the NPCN offers a means of expeditious message dissemination over wide areas. The operation of the network in 1951 was described as follows:

> In many states radiotelegraph stations form the basic framework for complete state coverage. Radiotelephone stations function as feeders to the radiotelegraph stations, and as relay points for other systems. Alabama, Arkansas, California, Illinois, Indiana, Missouri, and Ohio are a few of the states so organized. In Illinois, Indiana, Michigan, and Wisconsin, among others, a common radiotelephone frequency of 155.37 megacycles is utilized by many of the various police agencies to exchange intrastate police messages. This same channel is also used to feed inter-state police messages to radiotelegraph stations for transmission to an out-of-state agency. These systems represent the acme of the communication process.[7]

Thirteen years later, the installation of CW equipment seems to be beyond the resources of most departments. In 1951, about 90 CW stations were listed as participating in the NPCN, mainly in the Mid-West and Pacific Coast areas.[8]

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[6]National Police Communications Network Directory, Sixth Edition (Detroit: Associated Police Communications Officers, 1951), p. 7.

[7]Ibid.

[8]Ibid., p. 25.

In 1962, approximately 80 stations in the same areas were listed, but many were operating on a limited basis during certain hours.[9] A letter from the Acting Secretary of the FCC, dated May 9, 1962, notes that ". . . the interest in radiotelegraph emission has been very limited for quite some time."[10] Another source listed 41 "active" CW stations in July, 1961.[11]

In reviewing the development and use of CW with various radio engineers, the apparent decline of the method is a result primarily of the expansion of high speed teletype networks and the difficulties encountered in recruiting and training competent radiotelegraph operators. The licensing requirements of the FCC for this position call for extensive technical knowledge; those possessing the requisites are attracted to better paid positions in private electronics industry.

Two other methods of intersystem communication over long distances have been attempted on an experimental basis. The military's successful use of radio-teletype and methods of single sideband transmission do not find permanent application in the police systems

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[9]"Communication Engineering," Radio Registry, 137, 1962.

[10]"A Letter. . .," The APCO Bulletin, 28:5, June, 1962.

[11]The APCO Bulletin, 27:6, July, 1961.

as yet.[12] Undoubtedly, the capital investment in equipment deters most departments from installing such facilities. It is particularly difficult to justify the expenditure required, because the bulk of communication usually consists of messages being relayed for other jurisdictions. With the continued growth of regional radio-telephone networks and private teletype facilities, it seems unlikely that any substantial demand for CW (or other types of emission) will develop unless costs are reduced, cost-sharing agreements made, or joint operation with the federal government is undertaken.

In departments able to justify the position, a "radio operator" may be assigned at the location of the main radio equipment installation. His duties are typically to insure proper and continued operation of the equipment, and he may in addition be responsible for conducting intersystem communication, by radio-telephone and/or CW. Because of the transmitting equipment maintenance, the radio operator must possess and advanced FCC license.[13]

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[12]A recent proposal submitted to the FCC advocates the use of forward propagation by ionospheric scatter (FPIS) to operate radio-teletype circuits.

[13]Section 89.163, 28 F.R. 14108 (1963).

IV. DISPATCHING FACILITIES

It has been pointed out that locating the dispatching and records units in close proximity offers advantages of expediting the flow of information and better use of personnel. Operating convenience is sometimes sacrificed, however, for the public relations value of displaying the dispatching facility in prominent view in a public area of the department. The operation is interesting to persons entering the area, and may create a favorable impression of the "police department in action." The hazards to security, operating problems, and the occasional discomfort experienced by personnel constantly under observation tend to favor placement in a more protected area. The facility should always be included in tours, "open houses," and the like, however.

Status boards are described as devices used to quickly indicate the availability of field units. Such a device is justified as a dispatching aid in the smallest as well as larger departments. A status indicator may be simply a wooden rack with "pigeon holes," into which assignment slips (complaint memos) are placed when the unit is dispatched, and removed when the unit calls back in service.

As the number of field units increases, a more compact arrangement is usually necessary. Switch controlled pilot lights may be used, with indicators at each dispatching position, on a large map visible to all positions, or both. The switches must be wired so that actuation at any position causes the same indication at all other positions. Many departments favor simple indication of green for "in service," and red for "out of service," and no illumination to indicate the unit is not assigned for the shift.

Placing of pilot lights on a large map showing beat boundaries is particularly valuable to dispatchers responsible for deployment of large numbers of field units. Each unit's status cannot be recalled from memory, nor can time usually be taken (or should be taken) to query a number of units to determine which is the closest to the assignment at hand.

Because beat boundaries change with periodic review of workload data, it is necessary to provide a means of changing maps and status lights accordingly. A convenient method is to photographically reproduce a map of the jurisdiction (or area if dispatching tasks are so divided) on translucent stock, and mount

it under glass or plastic.[14] A framework behind the map affords placement of indicator lights (on flexible leads) at any positions desired, and grease pencil or other temporary marking may be used to delineate beat boundaries.

If manual actuation of status lights is necessary by dispatchers, there is an understandable tendency to omit this operation when message volume is extremely heavy. The value of status indicators is greatest during these periods, however. A logical approach is to provide convenient storage slots or wells for complaint memos which also contain a "micro-switch" automatically actuated by insertion of a memo form. The status indication is thus changed for each unit whenever a complaint is stored pending completion in the slot assigned to the unit. Commercially available storage modules permit from 25 to 100 or more individual slots to be readily available to a dispatcher.

Occasionally, demand is expressed for more elaborate status indicators to show, for example, "out of service subject to call," or "out of service at headquarters." In one system containing six possible status conditions, it was found that the dispatchers did not have sufficient time to manually adjust the status switches

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[14]Copyright law must be observed with some maps.

required to display these indications, except during early morning hours when the distinctions were not particularly needed. At other times, complaint operators or other dispatchers personally queried the controlling dispatcher to either verify the displayed indication or to obtain more information.

Some systems have assigned the task of selection and assignment of field units to complaint operator personnel. This requires that current status of each unit be accurately reflected and readily available to them. In situations which require more than one unit, or in which several units are out of service, it may be necessary for the dispatcher to ascertain exact locations of units and either make the assignment decision himself or relay the information back to the complaint operator. The dispatcher is also more likely to anticipate correctly when units will be available. Complaint operators should indicate on complaint memos the beat in which the incident occurs, but the final determination of actual unit or units to be assigned to an accident is best left with the dispatcher.

The use of recording devices on radio communication channels is perhaps even more important than recording telephoned complaints. The elimination of the log keeping requirement by the FCC, which for many years required a transmission-by-transmission

entry in written form, has eased the dispatching burden considerably.[15] The value of such a record for internal administrative purposes remains, however, particularly when actual words used and precise times are included at minimum expense and inconvenience.

Access to playback equipment by supervisory officers may become quite important if a question arises about the exact transmission of a unit. For example, if an incoming priority message is misunderstood or misinterpreted, playback of the recording may resolve the difficulty. Access by other personnel is not without its drawbacks, however, because of the temptation to alter or destroy, a recording which might reflect disfavorably on an individual. Completely tamper-proof systems have not been offered to date, but such inclinations may be effectively discouraged.

The use of one channel of a multi-channel recorder as a time source of course is needed, but it may also serve as a deterrent to tampering if time announcements are made with sufficient frequency to indicate when a stoppage or other failure has occurred. A convenient method (where available) is to arrange a direct connection between the recording equipment's "time" channel and the time announcing

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[15]Section 89.175, 28 F. R. 14109 (1963).

facility of the telephone company. If the company's announcements are made every ten seconds, giving the time in seconds, a virtually continuous time track may be established.

The use of codes to speed up dispatching by shortening the length of messages has been found to be effective. Attempts to standardize the meanings of various designators is usually more successful on an area basis; a "national" police code, promulgated by the Associated Public-Safety Communications Officers (APCO), is widely used but with many local variations. Codes are also used to expedite message processing on CW and teletype networks.

Regardless of the kind of designations used, codes commonly signify the most frequent operational phrases used by dispatchers, such as in or out of service, call or return to station, etc. When attempts are made to compose more elaborate code lists, making provision for various types of complaints, the code can defeat its purpose by requiring the recipient to consult a list to ascertain the meaning. A reasonable compromise is to limit codes to operational phrases and to certain subject matter the broadcast of which, if overheard in plain language, could compromise the assignment.[16]

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[16]Frank Bramley, "Some Factors to Be Considered in the Selection of a Large Area Police Radio System," 36 J. Crim. L., Crim. & P. S. 60 (May, 1945)

Although not strictly a "code," a mnemonic device is useful in establishing uniform descriptions used by dispatchers and mobile units. Uniformity in describing persons and automobiles, among other items, aids in accuracy and expedites actual transmission time. For example, "CYMBAL" is advocated by APCO to describe "color, year, make, body, and license" of a car.

Coding the locations of assignments may be necessary if it is known or suspected that dispatching channels are being monitored by persons with criminal intent. A simple method is to supply field units and dispatchers with area maps marked with sufficient grid-lines to identify particular locations. The use of scrambling devices to defeat unauthorized monitoring has not yet met with any marked degree of acceptability by police agencies, primarily because of cost and engineering difficulties.

The addition of certain frequency sensitive devices to radio equipment permits individual mobile units or groups to be called to the exclusion of other groups on the same frequency. "Selective calling" describes generally the contact between dispatchers and one or more mobile units; "recall" applies to the actuation by the dispatcher of various signal devices in a mobile unit to indicate a call for the unit.

Selective calling has found limited application by police agencies, primarily because of costs and lack of any tangible benefits in limiting dispatching to certain groups or units on the same frequency. Recall capability, however, may enable units on routine duties (but away from their vehicle) to be summoned when a call requiring immediate attention is received. Recall devices should be considered particularly in one-man patrol operations; their use in other field activities may not justify the cost.[17] If most complaints to which a field unit is assigned require the unit to remain out of service until the complaint is resolved, there is little advantage in installing recall devices. In many situations, a field unit may advise the dispatcher of a telephone number at which he may be reached while out of service.

A relatively new application of the selective calling principle, permitted by the FCC if it does not interfere with manual communication, is automatic alerting of police by radio of intruder-actuated alarms, or of equipment malfunction.[18] The coding device permits the incoming signal to be identified as to source, and appropriate action may be immediately initiated by the dispatcher.

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[17]Generally, from 15 to 20 per cent additional over the basic cost of a mobile transmitter/receiver.

[18]Section 89.307(e), 28 F. R. 14112 (1963).

The development of emergency plans merits mention here. Major events involving large numbers of field units include large fires, aircraft accidents, automobile accidents at critical locations, severe storm damage, building explosions or collapse, and the like; and felonious criminal acts calling for manpower to cover large areas. The latter are usually quickly reported and the possibility of apprehension of suspects warrants the extensive deployment.

Because an incident of this type generates a large amount of radio traffic, advance designation of certain points to be covered within each beat and the procedures to be followed may expedite actual dispatching. Emergency plans should also clearly set forth the persons responsible for on-scene coordination and determination of emergency status, the frequencies to be used, notifications, and communications operations at the headquarters facility. A large map of the jurisdiction with movable markers is valuable in this situation.

To conclude the complaint processing operation, the dispatcher typically notes on the complaint memo furnished by the complaint operator the unit(s) assigned, the time of dispatch, the dispatcher's name, initials, or number, and the time returned to service. Time of arrival may also be recorded. The latter notations are best made by use of an automatic date-time stamp.

Some systems also make provision for noting the unit's location at the time of initial assignment; if field supervisors are able to monitor the transmissions of their assigned units, however, and the units respond to the initial call-up by the dispatcher with their location, this operation may (and should) be omitted.

The complaint memo may also serve as a report of the handling of a minor incident if the assigned unit reports the type of disposition to the dispatcher. The dispatcher checks or notes the complaint memo appropriately, including names of the officers handling. Although this process relieves field officers of some "paperwork" less supervisory control results.

V. RADIO SYSTEM GROUPS

It is not the intention of this work to explore the development and design of the many kinds of radio equipment available to the police service. Understanding of how it is best used, however, does require study of certain technical, as opposed to administrative, phases common to all police dispatching systems.

Mention has been made of the division of large groups of mobile units into smaller, more effective dispatching arrangements operating on separate channels. In order to properly allocate units and dispatchers, it is necessary to provide separate frequencies at

least part of the time; as the system increases in size, or to meet certain needs, the capability of switching frequencies may be needed by mobile units.

Designations for systems are based on how the channels are used. The variations found in systems sharing a common name is usually a result of the manner in which mobile-to-mobile communication is handled. For example, a duplex system infers a two frequency arrangement, with dispatching on one and all mobile units on another frequency.

In this arrangement, only the dispatcher would hear the mobile unit calling. If mobile transmissions are simultaneously rebroadcast on the dispatching frequency as they are received (mobile relay), all other mobile units as well as the dispatcher hear the calling unit.

Table I, System Designations, describes the more common groups. The allocations discussed previously are made using one or more of the systems listed. With the exception of CW, each of the systems normally uses push-to-talk radio equipment; that is, each transmitter in the system is inoperative until a switch is actuated to permit communication, and released when the transmission is complete. The transmitting condition makes simultaneous reception impossible. In a few systems (and commonly in public mobile telephone

TABLE I

SYSTEM DESIGNATIONS

System		Base Transmits	Mobiles Receive	Mobiles Transmit	Base Receives	Mobile-to-Mobile Communication
Simplex		F1	F1	F1	F1	All mobiles in range
Duplex		F1	F1	F2	F2	None (manual relay through dispatcher)
Duplex (Mobile Relay)		F1	F1	F2	F2	Automatic retransmission of F2 on F1 to all other mobiles
Duplex ("3-way")		F1	F1	(F1 (F2	(F1 (F2	If F1 selected, all mobiles in in range; if F2, none.
Multi-channel (by area or function)	A)	F1	F1	F1 or F2	F1 or F3	May be simplex or duplex on either channel--as above
	B)	F2	F2	F2 or F4	F2 or F4	
Multi-channel		F1---F_n	F1---F_n	Any four or less	F1---F_n	One channel selected as common to permit intercommunication

	Base Transmits	Stations Receive	Stations Transmit	Base Receives	Remarks
Intersystem	(F1	F1	F1	F1	
	(F1	F1	F2--F_n	F2-F_n	Cross monitoring
	(F1	F2	F1	F2	Repeater re-transmits F1 on F2 to all other stations
Continuous Wave Telegraphy (CW)	F1--F9	F1--F9	F1--F9	F1--F9	

systems), equipment is designed to afford simultaneous transmission and reception, known as "full duplex."

Among the advantages claimed for full duplexing of a police communications system are immediate response as a message is completed, without waiting for release of the calling unit's carrier, and ability to interrupt a routine message with emergency traffic. To enable a full duplex system to function, each vehicle must be equipped with two antennas or a duplexer. The transmitter and receiver are usually modified in the power supply and control components to permit such operation. Although the engineering changes involved are minor, they may account for an increase in system cost. If additions to the system are made, the cost per unit will be significantly higher than the "production line" equipment readily available.

The full duplex system has the effect of encouraging needless conversation between the dispatcher and mobile units. In one system studied by the writer, the tendency is to use the system in a manner similar to normal telephone communication. This was particularly evident when dispatchers were receiving or transmitting descriptions of wanted persons or crimes in progress. Instead of transmitting a standard description or making definite assignments for particular units approaching a crime scene, much time was taken up with

unnecessary repetition of information already transmitted and acknowledged by responding units.

One of the justifications offered for a full duplex system is that a unit other than the calling unit can transmit emergency traffic, interrupting the routine message in progress. In practice, this capability is the same for mobile units in either a full duplex or a regular duplex "push-to-talk, release-to-listen" system. The mobile unit making the initial call will likely capture the dispatcher's receiver, and until the mobile's carrier is released, an emergency call of less signal strength at the receiver will not be heard in either system. The dispatcher in a regular duplex system has the same capability of interrupting a mobile unit to dispatch emergency traffic to other mobiles. The only advantage gained by full duplex operation is that the calling mobile could also monitor an emergency message if the message interrupts the mobile's transmission.

Knowledge of the various system combinations possible is important to the police administrator who may be faced with demands for special communications applications. Some of the complexities of usage of particular systems calls for professional engineering assistance, but at least a need is more likely to be met with awareness of the possibilities involved.

For example, mobile relay operation is not permitted by the FCC on certain frequencies, but on the same frequencies a simplex operation may be entirely satisfactory. Equipping foot officers with radio communication capability may be needed; but it may not be possible on the regularly used frequencies because the more powerful mobile units override weaker portable equipment. The same holds true of most radio-equipped motorcycle operations.

"Task forces" may generate a large amount of radio traffic which is not concerned with the handling of routine called-for police services. Typically, many suspicious persons and vehicles are the targets of task force operations; the ensuing name and license checks may account for a significant proportion of total radio traffic. Added to this are the wanted checks requested by other line units in the course of their tours of duty. In the Dade County, Florida, Department of Public Safety, for instance, the total amount of this type of traffic justified the recommendation for a separate frequency to directly link each mobile unit with the records information center. This frequency also serves as a "county-wide" frequency if a mobile unit is required to operate outside its normally assigned zone with its separate frequency.

Investigative and surveillance operations may also justify a special frequency. In low power applications, using portable

"walkie-talkie" equipment, the message volume may not be great, but the importance of the mission and the security of communications regarding it may call for an exclusive channel. The FCC has allocated one frequency especially for this use;[19] a petition submitted to that agency asks authorization for law enforcement agencies to operate such equipment on any frequency assigned to the police radio service if no interference is caused to the primary licensees.[20] This would make unauthorized monitoring extremely difficult, of course.

VI. OTHER TECHNICAL CONSIDERATIONS

Almost all police radio systems at the present time use frequency modulated transmission (FM). The original development of police radio, however, followed the commercial broadcasters' practices of using amplitude modulation (AM). World War II contributed to the technical refinement of FM, especially in tactical military applications; following the War, the availability of new spectrum space in the higher frequency ranges resulted in the great

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[19]Section 89.309, 28 F. R. 14114 (1963).

[20]Associated Public-Safety Communications Officers, Inc., Petition for Rule Making, December 5, 1962.

majority of police systems abandoning lower frequency AM for higher frequency FM.[21]

Thus, the use of amplitude modulation for municipal police communication in the frequency ranges above 30 megacycles has been all but rejected.[22] Frequency modulation provides much greater intelligibility and freedom from noise interference. Reception characteristics are also superior, since strong signals override weak signals (such as those of other systems) with little or no loss of intelligibility.

The latter characteristics sometimes may be taken advantage of in system planning. If an agency is faced with a critical frequency problem, and no allocations are locally available in the desired frequency range, two separate portions of the jurisdiction may share the same mobile frequency with separate dispatchers. The areas must be separated to the extent that signal strength levels in each area override the signals of the other area. Directional antennae

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[21]Don Beachler, "FM Police Radio and World War II" National Police Communications Network Directory and Reference Guide 5th Edition (APCO, Inc., 1946), p. 110.

[22]Milton B. Sleeper, (ed.), Mobile Radio Handbook (Great Barrington, Massachusetts: FM-TV Magazine, 1950), p. 7.

and closely controlled transmitter power also help to reduce any possibility of signals of equal strength occurring at the receiving point in each area.[23]

Propagation characteristics of the four frequency bands now used by police radio systems for communication with mobile units vary considerably, and must be recognized when planning is undertaken.[24] Police allocations above 30 mc are listed in Table II.

The most significant characteristics of the listed bands are as follows:

Low band: Best suited for coverage of large areas if repeaters in other frequency bands are unavailable.[25] Mobile-to-mobile communication range is greatest in this band, thus its extensive use in county and state police systems. Signals may not adequately penetrate dense, built up areas, tunnels, etc. Interference from manmade noise sources is greatest in this band; also

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[23]Chandos A. Rupinski, Jr., W. B. Smith, Jr., "Logic of Base Station Radio Coverage in the Mobile Telephone Service," Los Angeles IRE Bulletin, 15:16, December, 1962.

[24]The frequencies allocated to the Police Radio Services between 1610 kc and 2490 kc are limited to comparatively few jurisdictions, and used for dispatching only.

[25]J. A. McCormick, "The 450 MC Band - A Comparison and Evaluation," paper read at The Special Industrial Radio Service Association, February 5, 1962.

TABLE II

FREQUENCY BANDS, 1964

(Derived from Section 89.309, 28 F. R. 14113 (1963)

Frequency Range	Common Name	Number of Frequencies	No. Shared with Other Services	Number Reserved for State Police	Normal Channel Spacing
37.02 - 46.02 mc	Low band	153	11	58	20 kc
72.02 - 75.98 mc	Operational fixed	80	All	None	20 kc
154.650 - 159.210 mc	High band	66	None	10	30 kc
453.050 - 458.950 mc	UHF	38	All	None	50 kc

ionospheric propagation ("skip") may originate from foreign stations as well as United States sources.[26] Skip interference may, in times of intense sun spot activity, render local systems unusable.

Operational Fixed: Used exclusively for relay and repeater operations. All frequencies are shared with other services; they are closely regulated and limited due to possibility of interference to television channels 4 and 5.[27]

High band: Has the effect of "bouncing" into shielded areas of high rise buildings. Mobile-to-mobile communications is not generally satisfactory without use of mobile relay. Requirements for antennae permit smaller configurations which result in greater effective radiated power for both mobile and base installations. The 150 mc band has found wide application in metropolitan areas.[28]

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[26]Section 89.101(8), 28 F. R. 14105 (1963).

[27]Section 89.101(c), 28 F. R. 14104 (1963).

[28]Joint Technical Advisory Committee (JTAC), Radio Spectrum Conservation (New York: McGraw-Hill Book Co., Inc., 1952) p. 167.

UHF: The short wave length of 450 mc frequencies causes even greater penetration effects than that of 150 mc in dense urban areas. Tree foliage, however, seems to attenuate UHF frequencies. Thus this band is used extensively in cities and for directed point-to-point links. As in 150 mc applications, physical size of antennae permits high gain, readily directable radiation patterns.

The many possible combinations of apportioning frequencies among dispatching and mobile channels described previously is thus further enlarged by appropriate selection of frequency bands. For example, in the Chicago Police Department's system, the eight primary "zone" dispatchers transmit in the UHF band, but mobile units transmit on high band frequencies. This "cross-banding" was partially brought about by lack of available high band frequencies in the number needed; however, other advantages are described as follows:

> The inherent advantages of this system configuration are many. (1) High power base stations and relatively lower power mobile transmitters are widely separated in frequency, reducing the possibility of destructive interference. (2) At the present state of the art, mobile transmitters generally have more range when frequencies in the 150 mc VHF band are used. Higher powered transmitters available for fixed station use in the 450 mc band, and high gain base station antennas are available which "equalize" the propagation differences in the two

> bands. (3) Ambient noise in the 450 mc band is less severe making it more suitable for mobile receiver applications. (4) Special systems are more easily implemented to provide mobile relay functions and full duplex mobile operation. The equipment complexity is not much greater than a comparable single band unit. The three-to-one frequency relationship between the 150 and 450 mc bands makes it possible to use a single antenna on the mobile unit. Most manufacturers make equipment which is physically interchangeable for 150 mc and 450 mc operation. The base station complexity may be increased in multi-element gain type antennas are used since a separate antenna will be needed for each band.[29]

A final technical consideration worthy of note affects selection of sites for the location of radio equipment. In the frequency bands used by police systems, many other mobile radio systems are licensed, all with similar problems of coverage, frequency availability and the like. The result may be a concentration of radio equipment of many licensees at a particularly advantageous location, for instance a mountain-top overlooking a city, or on top of the tallest building in the area.

When several transmitters are so located, they may tend to degrade receiver performance by combinations of their operating frequencies generating a frequency product which affects or is accepted

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[29]Curtis J. Schultz, "Better System Design Through Cross-Band Operation," Los Angeles IRE Bulletin, 15:20, December, 1962.

by a receiver. Tracing the source of intermodulation, as the effect is known, may be extremely difficult because of many possible combinations at a multi-transmitter site. Devices are available which reduce intermodulation effects, but if a frequency product is identical to the receiver's frequency there is no way to differentiate between desired signals and the interfering signal. The only remedy is to relocate the transmitter and/or receiver site.

CHAPTER VI

FEDERAL REGULATIONS AFFECTING POLICE COMMUNICATIONS

Both land line and radio communications in the police service are subject to the rules and regulations of the FCC. Radio regulations particularly are worthy of note because of the degree of control that has evolved. The radio spectrum, frequency coordination, and operating procedures are treated in this chapter with the Commission's regulations in mind.

I. THE RADIO SPECTRUM

The Federal Government's role in the regulation of police radio communications has long been recognized, and, as in the case of most regulatory bodies, severely criticized at times.[1] The predecessor of the FCC was the Federal Radio Commission, created in 1927; the FCC superseded the Radio Commission in 1934, with enlarged regulatory powers.[2]

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[1]JTAC, op. cit., p. 12.

[2]General Services Administration (GSA), U. S. Government Organization Manual (Washington: Government Printing Office, 1964), p. 392.

The development of police radio is of course directly affected by decisions made at the FCC. The historical background of the Commission's actions is much too involved for inclusion here; the objective is to present some of the requirements which particularly affect system planning.

The FCC is faced with a difficult task. It must apportion frequencies among commercial broadcast uses and non-broadcast services, such as police radio. Although it is described as an independent agency, its actions are responsive to politically oriented sources.[3] The Commission's prime resource, the radio spectrum, is not available without prior restrictions, since the Federal Government claims large portions of spectrum space for its military and other operational uses. The Inter-Agency Radio Advisory Committee (IRAC) under the Director of Telecommunications Management performs functions similar to the FCC's, but only for Federal agencies.[4] Of further limiting affect are the many international treaties which apportion spectrum space world-wide.

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[3]The "all-channel TV receiver" legislation (H.R. 8031) passed by Congress as Public Law 87-529, and signed by the President on July 10, 1962, is typical.

[4]GSA, op. cit., p. 61.

Most of the problems which beset system planners are attributable to the lack of usable frequencies.[5] Competition for frequencies is intense, not only between broadcast and non-broadcast users, but within the group--for example, between public-safety and business and industrial radio users. The Police Radio service is part of the Land Mobile Group; efforts to secure additional frequency allocations for all the Land Mobile Services have not been notably successful in recent years.

The police position in the competition for frequencies is summed up by Brooking testifying in a statutory inquiry into frequency allocations between 25 and 890 mc.:

> On an overall basis, I think our position can be summarized as follows: There are some areas in the country in which the police have no special problem of frequency shortage. These areas, however, are usually of relatively low population density in which, as a general matter, other services also encounter relatively less difficulty in finding frequencies. On the other hand, in more densely populated areas, we encounter continuing and serious difficulties in our efforts to satisfy police radio requirements. These areas are not concentrated in any one state or in any one region. They are found throughout the country and, in general, include the cities of substantial size and important economic and industrial development. In other

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[5]R. P. Gifford, "Radio Spectrum Management," The APCO Bulletin, 28:6, October, 1962.

> words, while there may be exceptions, as a general rule we encounter frequency difficulties where frequencies are also short for most other services--and where we need them most. [6]

One of the actions intended to make available additional channels was the petition of the Electronics Industry Association's (EIA) Land Mobile Section filed on October 1, 1962. The petition asked that UHF television channels 14 and 15 (470 - 482 mc) be reallocated to the Land Mobile Radio Services, because of the pressing demands for additional frequencies and the relatively little use of these channels for television broadcasting.

The FCC denied this petition (and several related rule making proposals) on March 26, 1964, stating in part:

> 110. Requests submitted by the non-broadcast, non-Government services during the course of this proceeding were predicated, at least implicity, upon the possibility of a major reallocation of the frequency bands now available for television broadcasting. Subsequent developments as outlined in preceding paragraphs have now eliminated this possibility; and it is, therefore, apparent that major allocation relief cannot be provided for those services in the 25-890 Mc/s band. During the intervening period moreover, system operating characteristics have been altered and technological improvements affecting spectrum utilization have been made. It is also apparent that spectrum needs will have changed substantially during

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[6]Testimony of Robert E. Brooking, FCC Docket No. 11997, June, 1959, p. 2.

> this period. Consequently, express consideration of allocation requests and supporting data submitted in this proceeding would now be fruitless and unrealistic. Therefore, while recognizing the existence of significant and important requirements for the non-broadcast services, our attention must be directed toward measures which offer a promise of more efficient utilization of the remaining portions of the spectrum, between 25 Mc/s and the lower level of microwave frequencies in the light of conditions as they exist today, without resorting to a major reallocation of additional exclusive spectrum space to the land mobile service at the expense of other non-Government radio services.[7]

The FCC's instructions in disposing of this petition are clear; the land mobile service must make better use of the presently assigned spectrum, and cannot look to reallocation of television channels in spite of apparent availability. It is not at all clear on how better use may be brought about considering the present state of the art and the growth of land mobile systems.[8]

FCC policies and the decision-making affecting police radio are constantly under review. Technical innovations as well as political considerations all work to make any estimates of likely sources of relief from frequency congestion meaningless. Suffice it to say that

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[7]Report and Order, FCC Docket No. 11997, Washington, D. C., 26 March 1964, p. 31.

[8]Personal Interview, Joseph M. Kittner, Counsel for APCO, April, 1964.

the problem of frequency availability is likely to remain a significant factor in the design of police radio systems.

II. FREQUENCY COORDINATION

The FCC is faced with a problem of allocating the few frequencies available to it in an equitable and fair manner, as has been pointed out. Within the Police Radio Service, the same situation exists. The responsibility for actual determination of how many and which frequencies shall be assigned to a police agency rests of course with the Commission,[9] but it is assisted in this task by voluntary Frequency Advisory Committees for each state.

The function of these Committees is essentially to make sure no harmful interference is caused to other systems by the operation of a proposed system. An application may require the Committee to perform extensive research in determining matters such as physical separation, propagation paths, the existence of other systems licensed on adjacent channels but in another service (usually Local Government). If the application is favorably commented upon by the Advisory Committee, the statement of the Committee

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[9]Section 89.51, 28 F. R. 14101 (1963).

accompanies the application to the FCC, where it is usually processed without further delay and a license granted.

Seeking a letter of clearance from an Advisory Committee is generally considered the most satisfactory method for processing the application. If a dispute arises or other considerations merit the action, an application may be forwarded to the FCC without a clearance letter if it is accompanied by a statement that all licensees within 75 miles and operating within 30 kc of the proposed system have been notified of the intended operation, and a report based on field study of the likelihood of interference. [10]

The Frequency Advisory Committees may at times be composed of one or two individuals who attempt to exercise unreasonable control over local allocations beyond that authorized by the FCC. Section 89. 15(c) points out:

> The functions of Frequency Advisory Committees are purely advisory in character, their comments are not binding upon either the applicant or the Commission, and must not contain statements which would imply that . . . (they) have any authority to grant or deny applications. [11]

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[10]Section 89. 15(c), 28 F. R. 14101 (1963).

[11]Sections 89. 15 (b) and (c), 28 F. R. 14100 (1963).

III. OPERATING PROCEDURES

The growth of police radio systems has brought about less stringent individual licensing requirements for those actually operating transmitters. From the original concept of a person always on duty at a transmitter site with an advanced class of FCC license, present regulations require only that the station licensee shall authorize individuals to operate equipment, if transmitting on frequencies above 25 mc.[12] Possession of a first- or second-class radio-telephone or radio-telegraph license is required for maintenance and installation of transmitting equipment.[13]

The elaborate records-keeping once required by the Commission has also been reduced for police agencies. Records must be maintained for all technical maintenance performed on transmitting equipment, but the message-by-message "log" is no longer required.[14] The governing section specifies only that the written signature of the person responsible for the operation of transmitting equipment be recorded when going on and going off duty, along with the period of duty.[15]

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[12]Section 89.163 (c), 28 F. R. 14108 (1963).

[13]Section 89.163(a), 28 F. R. 14108 (1963).

[14]Section 89.175(c), 28 F. R. 14110 (1963).

[15]Ibid.

There are, of course, many other regulations promulgated by the FCC which control installation and operation of police radio stations. The Commission places a great deal of reliance on police agencies to "police themselves," in effect; but the Commission may, and has, resorted to levying fines against an offending agency for repeated violations of regulations, failure to respond to official communications, etc.[16]

A common violation committed by many police agencies is failure to properly identify the base and mobile stations. If operating on separate channels, the base station and at least one mobile unit must transmit the assigned call letters or an approved identifier at least once every 30 minutes.[17]

Section 65 of the Communication Act of 1934 prohibits the unauthorized interception of police broadcasts for disclosure or to the benefit of the interceptor.[18] As has been pointed out, those with criminal intent find it useful to monitor police dispatching frequencies in order to avoid apprehension. Other persons also find monitoring useful, however; news-gathering agencies and tow truck and ambulance

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[16]Personal Interview, McCue.

[17]Section 89.15(d), 28 F. R. 14108 (1963).

[18]48 Stat. 1103 (1934), 47 U.S.C. 605 (1959).

operators are typical. When improper use of information gathered by monitoring police broadcasts is made, enforcement may be brought under Section 605. Local laws and ordinances have not enjoyed noteworthy success in prosecution of violators, primarily because of the reluctance of the courts to interfere with what is alleged to be "freedom of the press" or "freedom of the air waves."[19]

A case worthy of note recently adjudicated involved a former police officer who installed 30 receivers to monitor various public safety departments in the San Francisco Bay area. A private teletypewriter circuit was obtained to link the monitoring site with local commercial radio stations and newspapers. The information gathered by monitoring was then transmitted to participants for a fee.

The Federal Bureau of Investigation investigated the case and secured the arrest of the operator for violation of Section 605. The Federal District Court in San Francisco granted a defense motion for acquittal, stating that police agencies had taken themselves "out of the protection of the statute by voluntarily giving up privacy."[20] The

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[19]Personal Interview, Dee W. Pincock, Assistant General Counsel, FCC, December, 1962.

[20]New York Times, November 28, 1962.

defense attorney stated in effect that it was common practice for news media to monitor police broadcasts.[21]

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[21]Ibid.

CHAPTER VII

EVALUATING SYSTEMS DESIGN

The many approaches to system design discussed in this work imply that each system must be evaluated on its own merit to determine if it is meeting its objectives. In order to assist in the process of evaluation, certain criteria are presented herewith. These were derived by the writer as a product of interviews with personnel responsible for the operation of police radio systems and as a result of personal study of several systems. Section I discusses land line facilities; Section II radio facilities. Section III applies the criteria developed in case studies.

I. LAND LINE FACILITIES

Determination of the adequacy of land line facilities generally will depend on findings concerning:

1. Capacity of incoming trunk lines and tie lines.
2. Time required to process complaints from reception to broadcast.
3. Quality of information secured by complaint operators.
4. Attitudes of operators toward public.

5. Compliance with department policies concerning complaint processing and investigation.
6. Measures of complaint operator workload, and uses thereof.
7. Effectiveness of inter-department communications--field originated requests, file checks, etc.
8. Methods of selecting, training and supervising operators.
9. Justification for private land line facilities.
10. Need for teletype or telegraphic communications locally and interstate.
11. Use of records generated by operators.
12. Means of recording actions taken.

Data to aid in the evaluation of land line facilities may be gathered in several areas, some of which have been mentioned previously. Among these are:

1. Times and frequency of "all busy" conditions on incoming telephone lines.
2. Complaint memo tallies.
3. Time studies of response and processing periods.
4. Volume of interstate or regional messages.

5. Volume and nature of department-originated requests.

6. Review and analysis of recorded conversations.

II. RADIO SYSTEMS

Evaluation of the adequacy of a radio system will include:

1. Quality of design, determined by
   a. Reliability
   b. Flexibility
   c. Effectiveness
2. Methods of dispatcher selection, assignment and training.
3. Methods of staffing and supervision.
4. Anticipated results of future requirements on present system.
5. Use of dispatching records; integration with other records processing.
6. Capability of communication with other agencies.
7. Use of dispatching facilities including
   a. Maps divided according to manpower deployment.
   b. Status indicators.

c. Intercommunication capability especially for processing priority calls and field-originated requests.

d. Emergency plans and procedures for assignments to various types of complaints.

e. Recording devices.

8. Compliance with current FCC regulations.

9. Physical arrangement of facilities.

The following elaboration may aid in assessing design quality:

1. Reliability of communication. Voice transmissions from mobile units as well as those from dispatcher should be of the highest intelligibility; the usable communications range should include every part of the area of operation, without any "dead spots"; reception of atmospheric noise and man-made electric interference should be minimized; and the frequencies employed in the system should be as free as possible from interference by other radio systems. Mobile radio equipment should be capable of withstanding the rigorous demands of police service; base station and mobile installations should provide ease of operation and ready access for maintenance, but not to the detriment of system security; and means of maintaining communication

during power failures or other breakdowns should be provided.

2. Flexibility. The system should be capable of accommodating changes brought about by revised tactical operations; channel usage should be balanced, with functional assignments of channels consistent with needs; dispatching facilities should provide means of expeditiously handling emergency situations; and dispatching manpower should be in proportion to demand.

e. Effectiveness. The system should provide the fastest possible means of recording and exchanging information between each user; access to information at headquarters needed by line units should be immediate, and supplied with minimum interruption to regular dispatching; responsibility for control and coordination should be established and exercised at all times; and each user of the system should be governed by specific procedures.

Data useful to radio system evaluation may include:

1. Inventories of the number of units served during each time period, along with any unusual but anticipated communications requirements they may have.

2. Volume of field originated requests, and the routings necessary to fulfill requests.
3. Volume of intersystem messages, with breakdown as to source or addressee.
4. Time studies of the processing interval from reception of complaint memo to initial call-up of the unit to be assigned, and duration of message exchange (see below).
5. Transmitter time accumulated and transmitter actuations for each frequency used.

III. CASE STUDIES

The following case studies are presented to demonstrate the application of the criteria above to actual operations.

Dade County, Florida. The Public Safety Department's communications system provided complaint operators to receive incoming telephone calls for police service at the central headquarters. The operators completed complaint memos, routing them via conveyor belt to one of three "zone" dispatchers, as appropriate. Mobile relay operation was employed in two zones only, due to lack of suitable frequencies. As the study began, a substantial number of complaints were received from officers regarding their inability to establish

communication with their dispatchers during peak periods. Dispatching personnel expressed similar views. In order to establish the validity of the complaints, compilations were made of certain data which had been accumulated.

The data available, transmitter time and actuations, was generated by a running time clock connected to each of the three base station transmitters used for the north, central, and south dispatching zones, respectively. In addition, a counter was connected to each to register the number of times the transmitter was keyed (actuated by the dispatcher).

The initial analysis of the data gathered revealed that the total workload was disproportionately divided among the zone dispatchers. If the observed disparity in workload involved levels well under a point at which service deteriorated, the difference would have been of little note. This was not the case, however. The zone processing the largest message load was the north; samples of workload for this dispatcher revealed that at any point in time during peak hours a field unit had less than a 50 per cent chance of establishing communications.

It was found, for example, that between 01: 13.0 and 02: 13.0 hours on Sunday, January 20, 1963, the north dispatcher was engaged in message exchanges 38.4 minutes of the 60 minute period. A message exchange is defined as the total carrier-on time of both the originator and

the addressee accumulated from initial call to final acknowledgment. It includes the time lag between cessation of one carrier and the start of another if, by the nature of the message it is understood by all users that the message exchange is still in progress.

To further investigate the effects of dispatcher workload on system operation, the relationship between transmitter time and actuations was examined. At first glance, the total time a transmitter was operated would appear to be proportional to the number of times it was "turned on" (actuated). Table III, illustrated herein, tends to confirm this.

Regression lines were calculated and plotted, as shown in Figure II. The "all zones" line indicates a high degree of correlation (.9+) between time and actuations. Of particular interest is the effect of increased loading by zone.

The relationship was found to be curvilinear rather than linear. Starting with the south zone and going through the central zone, messages tend to become shorter as actuations increase. The implication is that dispatchers do not or cannot take "extra time" to handle messages--that the time is simply not available to them.

Alternatives to reducing workload and increasing capacity were investigated. Analysis of the number and nature of wanted checks pointed to an exceptionally large share of time devoted to recording

TABLE III

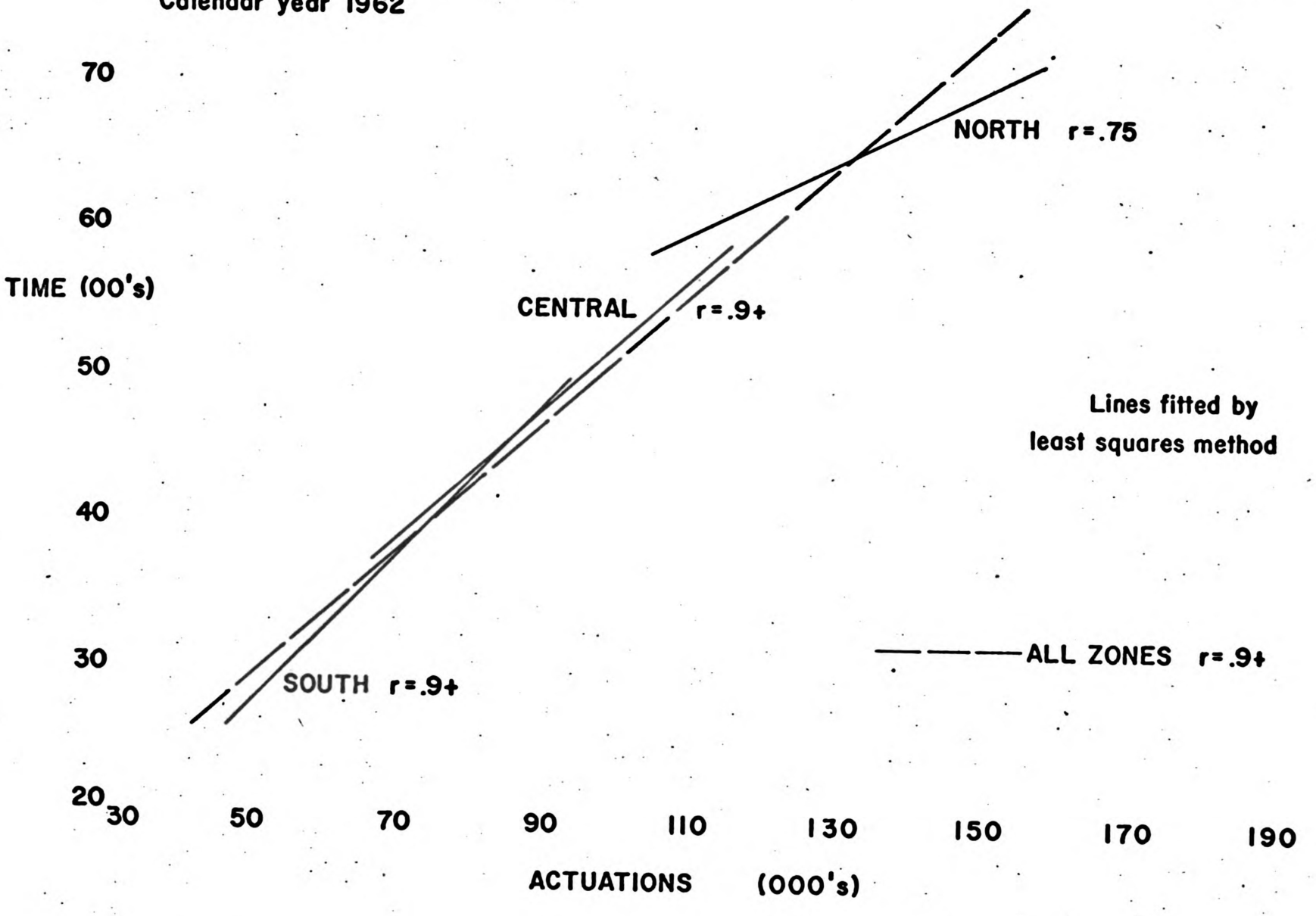
TRANSMISSION TIME AND TRANSMITTER ACTUATIONS
Calendar Year 1962

Zone	Time	Percent of Total	Actuations	Percent of Total	Time/Actuations
North	77,553.9	42.8	1,559,398	45.0	.0497
Ave./Month	6,463		129,950		
Central	62,396.3	34.5	1,187,572	34.2	.0525
Ave./Month	5,200		98,964		
South	41,165.0	22.7	721,340	20.8	.0571
Ave./Month	3,430		60,119		
Totals	181,115.2	100.0	3,468,400	100.0	.0522

REGRESSION LINES, TRANSMITTER TIME & ACTUATIONS

BY ZONE

FIGURE II



and relaying of information about suspicious subjects or vehicles encountered by line units. In the case of persons, this process involved the noting of name and other identifying data, transmitting the request for a check by pneumatic tube to the Records Section, waiting for a return, and, in the case of "possible wants" securing additional information and checking by teletype.

Checks for stolen vehicles were usually made by reference to a visible file of current stolen cars accessible to each dispatcher, and the time involved in this type of check was considerably less, of course.

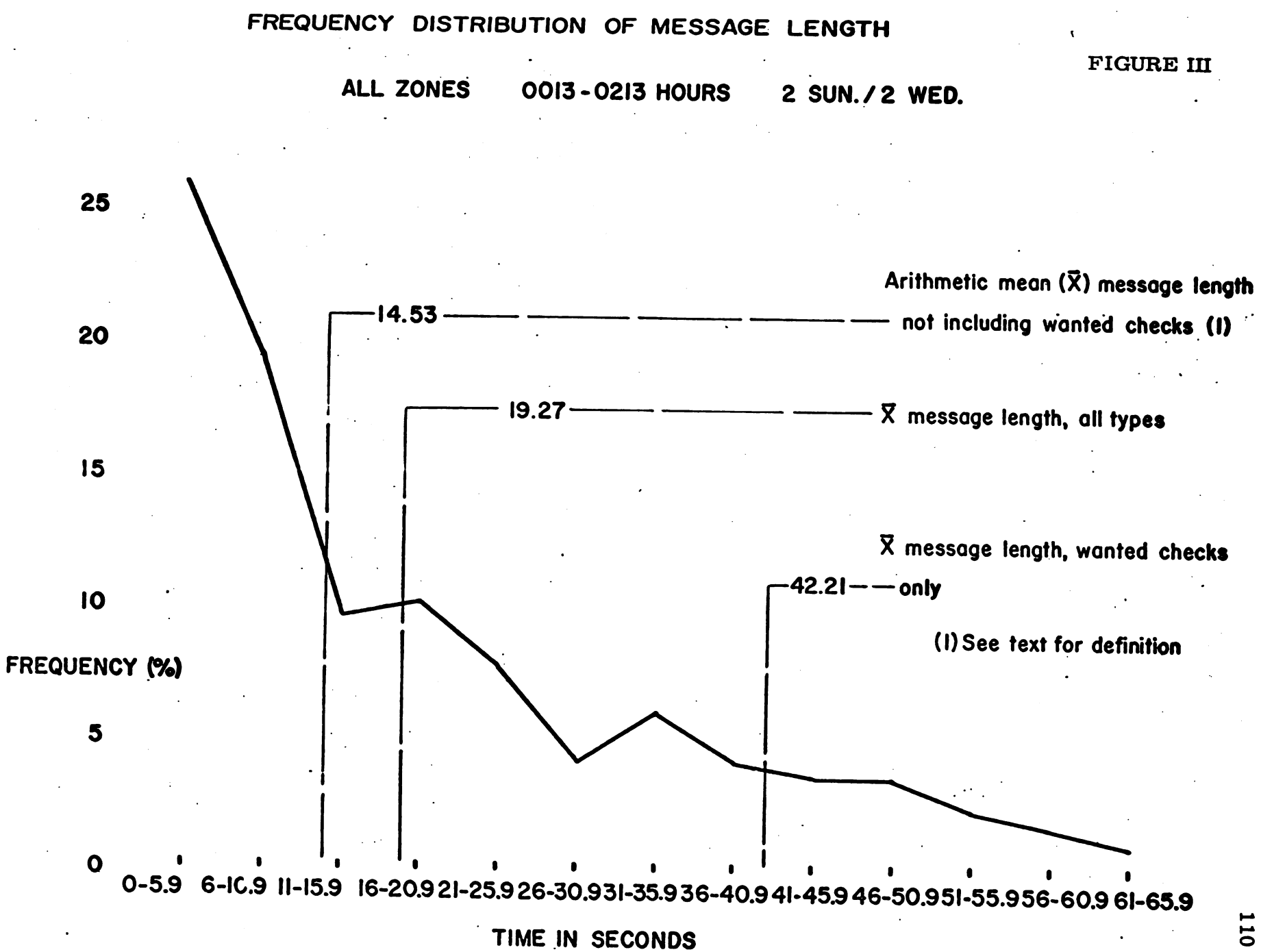
The proportion of each type of wanted checks was found to be fairly consistent by day of week and by zone, based on the data available. The north zone usually accounted for 50-60 per cent of subject checks, with the central and south zones 30-40 per cent and 10-20 per cent, respectively. Checks by type were divided as follows:

Subject	=	30-38 per cent
License	=	54-61 per cent
License Registration	=	6-10 per cent

Total checks on Friday and Saturday nights were about 12 per cent above the average total of 362 checks daily.

The frequency distribution of message length (message exchange) was found to follow a normal course. Figure III,

FIGURE III


FREQUENCY DISTRIBUTION OF MESSAGE LENGTH
ALL ZONES 0013-0213 HOURS 2 SUN./2 WED.
25
20
15
10
5
0
FREQUENCY (%)
14.53
19.27
42.21
Arithmetic mean (X̄) message length not including wanted checks (1)
X̄ message length, all types
X̄ message length, wanted checks only
(1) See text for definition
0-5.9 6-10.9 11-15.9 16-20.9 21-25.9 26-30.9 31-35.9 36-40.9 41-45.9 46-50.9 51-55.9 56-60.9 61-65.9
TIME IN SECONDS

illustrating this distribution, also indicates average (mean) time for exchanges, with and without wanted checks included. As indicated, if wanted checks were removed from the general dispatching workload, a significant reduction or shortening of average message length would have occurred.

In this case, the establishment of a second mobile frequency to permit rapid processing of wanted checks and as a common "interzone" frequency was justified.

Summary. Flexibility and effectiveness in the radio system was found to be inadequate. Land line facilities were all designed to expedite complaint processing, and performed well in this regard; the output to field units, however, was hampered by workload factors and frequency congestion. Recommendations were implemented which resulted in mobile relay operations in all three zones (all using one-man patrol assignments), and more equitable dispatching workloads for each zone. Effectiveness was enhanced by establishing a "county-wide" frequency as described.

Boston, Massachusetts. The Boston Police Department was found to be operating 157 radio equipped vehicles, all sharing the same duplex frequencies, and all through a single dispatcher. Cross-band operation was used, but with an AM low band frequency for the base

station, and an FM high band frequency for mobile units. Full duplex operation was employed. During peak periods, the volume of message traffic caused many field units to abandon attempts at radio communication and resort to land lines, which were similarly over-burdened.

Because of anticipated increases in the motorized patrol fleet, each organizational unit was examined to determine maximum field deployment, and channels were allocated according to function so that balanced channel loading would result.

Time studies of complaint processing revealed weaknesses in the accuracy and completeness of information. Little administrative use was made of data available; for example, personnel were assigned uniformly throughout the day, although the data indicated considerable variation by shift.

Summary. The quality of radio transmissions was found to be seriously affecting reliability. The full duplex approach also contributed to needlessly prolonged conversation. Installation of an all-FM system, with channel switching capability in some mobile units, was advocated to assure both reliability and flexibility. Physical facilities were re-designed to shorten the interval between complaint reception and broadcast. Centralized maintenance was also provided to better control inventory stocks and improve preventive maintenance of new equipment, which required conventional push-to-talk technique.

Memphis, Tennessee. The agency apportioned its mobile units among two channels, each on a simplex basis, and each controlled by one dispatcher. Car-to-car operation was found to be inadequate at times, but flexibility inherent in the capability of switching channels did permit one dispatcher to control all field units during light message periods. Intersystem traffic was carried out by telephone for the most part, because many area agencies did not provide equipment to cross-monitor. Recording equipment was installed for radio channels, but not for telephonic communications.

The dispatchers maintained an item-by-item log, but not all types of complaints were entered. A message volume study revealed that each message exchange averaged 11.80 seconds, with peaks occurring in evening shifts, especially on Fridays and Saturdays.

Summary. Projections of message volumes indicated that the two channel system could support increased workloads, since at peak periods maximum transmitter time would approach 7.67 minutes per hour. Improvements were recommended in complaint memo handling and the elimination of unneeded records-keeping. Other recommendations provided for a common intersystem network in the area, improved recording devices, and intra-department processing of telephone calls.

Rochester, New York. A single dispatching frequency was shared with the County Sheriff in this system. The result was occasional competition for air time by the police department and the sheriff, with the City averaging about 68 per cent of total transmitter usage. System effectiveness was affected by interruptions for priority messages, since coordination could not be effected with the physical separation of the two dispatchers.

An elaborate status board for complaint operators was installed, but proved to be of limited utility because of its location in relation to the dispatcher. Supervision for the complaint/dispatching process was assigned to headquarters personnel who, because of other duties, were required to spend considerable time away from the communications center.

Summary. Separate channels were provided to permit added capacity for both police and sheriff's units, with a common alternate channel to permit intercommunication. The possibility of a centralized dispatching center was explored, and plans made accordingly.

The dispatcher was assigned responsibility for control of unit assignments, which resulted in better control of field resources. Supervision was specified and allocated, with noticeable improvement in system discipline and control.

CHAPTER VIII

MAINTENANCE PROVISIONS

Purchase, installation and maintenance of radio and land line equipment represents a substantial proportion of any agency budget allocations, especially as increasingly greater operational use is made of communications facilities. Three approaches are commonly found: purchase and maintenance performed by the agency (intra-department), equipment ownership by the department with outside maintenance, and lease-maintenance agreements.

I. INTRA-DEPARTMENT

The expenditure of funds for basic equipment must be enlarged for purchase of test equipment in this approach. Of even greater consideration, however, is the budget allocation which must be made for salaries of maintenance personnel, and the provision for working space and supervision.

Because of the salary costs, the agencies which can support their own maintenance staffs are limited to the larger departments, with a volume of work sufficient to keep at least one man working one shift. A strong argument for intra-department maintenance is the provision for emergency service. Department control may insure that service is readily available at any time.

The growth of other radio systems supported by a governmental entity may well justify a centralized maintenance facility, especially since the equipment used by other city departments is usually very similar if not identical. Better preventive maintenance, less inventory stocks, and less investment in expensive test gear are benefits worthy of evaluation.

II. PRIVATE CONTRACTS

Ownership of equipment by the agency with maintenance supplied by an outside contractor may meet the needs of departments unable to justify a full-time maintenance staff. Of importance here is a specific understanding of when and where work shall be performed, and the costs to be incurred.

The agency receiving this type of service should also determine that required frequency checks are performed, and that equipment complies with FCC requirements. These regulations must be met in any maintenance system, of course.

III. LEASE-MAINTENANCE

At one time, subsidiary companies of the American Telephone and Telegraph Co. offered lease-maintenance agreements to law enforcement agencies. The number of police departments availing themselves of this service was substantial, but on January 24, 1956,

the U. S. Department of Justice entered into a consent decree with Western Electric, Inc., thereby ending an antitrust suit filed January, 1949.[1]

The consent decree in effect took the common carriers such as AT&T out of the lease-maintenance business. Many of those concerned with police radio felt at the time that two results would likely follow as a result of Bell's activities:

> (1) the common carriers will attempt to secure for themselves all frequencies now reserved for private users, on the theory that a substantial quantity of those frequencies are serving private users through common carrier-owned equipment; and
>
> (2) as the number of private users who use their privately owned equipment decreases, the relative competitive force of those private users owning their own equipment also decreases; hence with competition minimized, the common carriers will be in a position to lower or raise lease-maintenance rates at will.[2]

The consent decree did not prevent Bell from offering lease-maintenance services if the agreements were subject to some form of public regulation. As a result, Bell lease-maintenance agreements are now found only in a few state and local situations.

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[1]Joseph E. Keller, "The Effects of the AT&T Consent Decree on Private Communications Operations," reprinted from The Petroleum Engineer, June, 1956.

[2]Ibid.

The manufacturers of radio communications equipment were quick to offer similar agreements, sometimes offering optional purchase of equipment. In evaluating the choices available, the agency should require a detailed listing of charges for each system component, and compare to outright ownership costs. The maintenance considerations are the same as described in private contracts.

CHAPTER IX

CENTRALIZED SYSTEM CONTROL

The availability of radio communications to departments of every size generates effects which go beyond the area of communications. A particular location may at one time or another be served by police at state, county, and local levels, all with their own radio systems. This chapter discusses the metropolitan concept and centralized "public-safety" services.

I. THE METROPOLITAN CONCEPT

The patterns of growth of urban areas have caused some interesting trends in police radio communications. Typically, the large "central" city was the first entity to install police radio. When suburban police departments were created, the central city commonly offered access to its communication system to the new agencies, sometimes at no cost or, in some cases, at a proportional cost usually in terms of message volume or number of mobile units served.[1]

In 1938, it appeared unlikely that smaller police agencies would ever be in a position to support independent communications systems. V. A. Leonard expressed this view:

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[1]Smith, op. cit., p. 292.

> The smaller communities may profit through coordination of their protective and investigating work with that of the metropolitan department. The latter can provide services in training, in criminal identification, in the operation of modus operandi systems, and can function as a communication center. All these are services which are now completely lacking in nearly all other police agencies and which the smaller police forces, whether acting alone or collectively, could never hope to provide for themselves.[2]

In 1964, with the benefit of 25 years, it is common to find smaller departments with their own radio systems, although the frequencies they use may not be exclusive. Gordon E. Misner notes that

> Metropolitan disorganization in the field of police communications is often as pronounced as it is in records and identification. There are few police jurisdictions in the nation which are not served by some form of police radio facilities. Disorganization, therefore, does not involve a scarcity of resources. On the contrary, in many metropolitan areas there would seem to be an over-abundance of transmitting stations.[3]

Thus, the problem of control and coordination of radio systems is found in almost all metropolitan areas. An exception is the Nashville-Davidson County Metropolitan Government; in this

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[2]Leonard, Police Communications Systems, p. 208.

[3]Gordon E. Misner, "Recent Developments in the Metropolitan Law Enforcement," 50 J. Crim. L., Crim. & P. S., 502 (1960).

case, the former city of Nashville police communication system was expanded to include all municipal police radio operations with the relatively minor exception of six small, subscription supported agencies operating a total of 20 radio equipped vehicles.[4]

Some appreciation of the extent of the coordination problem (even from the narrow communications viewpoint) may be gained by noting that in Cuyahoga County, Ohio, the city of Cleveland and 63 other law enforcement agencies carry out their responsibilities.[5] A survey conducted in that County favorably viewed the state of police communications as follows:

> This system has given the smallest departments in the County ready access to excellent radio service. It enables the smaller communities which cannot afford to finance a base station of their own to benefit from the facilities of the larger department. As a result, most departments in the county have a three-way communication system that links their patrol cars with a central dispatching unit and with each other. Also, since all departments utilizing the same base station are in radio contact with one another, patrol cars from neighboring communities can be dispatched to the scene of the incident in case of emergency.[6]

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[4]"A Survey of the Department of Metropolitan Police, Nashville-Davidson County, Tennessee, 1964," a survey report by the International Association of Chiefs of Police, p. 5.

[5]Metropolitan Services Commission, Police Protection in Cuyahoga County (Cleveland: Metropolitan Services Commission, 1958), p. 5.

[6]Ibid., p. 38.

The rather benevolent attitude taken by some of the central cities toward its smaller satellites is sometimes duplicated at the state level in communications services. The Commonwealth of Virginia, for example, integrates sheriff's mobile units in radio service in areas where county resources are not sufficient to support private systems.[7] Not all states share this view, however. The Minnesota Highway Patrol explains their policy:

> When the radio system was first authorized, many county sheriffs and municipal police departments approached us with the thought that their departments could utilize the radio system for their local activities.
>
> We were convinced that this was not practical for many reasons. Primarily, the local authority would not have direct control over their personnel; the cost of making long distance calls to our closest dispatching point in order to transmit a message to their car would be prohibitive; and, as the Highway Patrol expanded a saturation point would be reached in the number of messages handled to the degree where communications to all agencies would suffer. . .
>
> It was our belief that a radio system should be designed and engineered to fit the specific needs of each agency. This provides an effective communications media which is under the control of the single agency concerned.
>
> The local agencies were encouraged to set up their own radio systems with a common frequency for

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[7]Personal Interview, Captain J. T. Marshall, Virginia State Police, September, 1963.

> intersystem communication which the Highway Patrol could monitor. The state system then would be the backbone for the state-wide communications and be the means to obtain information and coordinate law enforcement activities.
>
> In our opinion, this system has worked out efficiently and to the mutual advantage of all.[8]

Three main premises seem to emerge when metropolitan police radio services are contemplated: They are: (1) incidents coming to the attention of police frequently affect more than one agency; (2) capability of mutual assistance at all organizational levels increases police effectiveness; and (3) flexibility to meet changing needs must be provided--both long term and tactical requirements. The method of achieving the capability desired, and coordination of units, is dependent on central communications control.

> Coordination of police radio broadcasting in a given area involves, however, more than a tacit limitation on the number of frequencies. It involves a realization--particularly on the local level--that coordination involves the physical facilities and equipment needed to monitor radio broadcasts on a regional basis. It involves also the ability to direct operations from one, central communications base station. This is presently impossible in a majority of the metropolitan areas.[9]

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[8]Arthur P. Lane, "The Minnesota Highway Patrol," The APCO Bulletin, 29:7, April, 1963.

[9]Misner, op. cit., p. 503.

The importance of police radio communications has obviously been recognized by departments of all sizes. It cannot be said, unfortunately, that awareness of the need to intercommunicate information about criminal activities is similarly demonstrated.[10] Some daily police operations inevitably result in "outside" agencies becoming involved in some manner.[11] As the number of small, largely autonomous law enforcement agencies in a metropolitan area increases, the number of inter-agency contacts increases in a geometric proportion. Considered with the mobility of the clientele in the area, some orderly system of communications should be available to the police agencies of the area. The concern with which both the "independent" and the control systems are viewed is not confined to the exchange of information that occurs somewhat informally, such as intersystem traffic relating to license registration or the more encompassing emergency incidents. Rather, the patrol officer in the conduct of his normal duties is all too often hampered, if not actually repressed, by his inability to gain rapid communication with an officer in an adjoining

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[10]Joseph A. Poli, "The Development and Present Trend of Police Radio Communications," 33 J. Crim. L., Crim. & P. S. 196 (July 1942).

[11]Edward Sofen, The Miami Metropolitan Experiment (Bloomington: Indiana University Press, 1963), p. 26.

jurisdiction who could assist him, or, upon occasion, with his own base station. Isolating line units by failing to provide communications capability, especially with a one-man car operation, is poor management practice at best, by the central system or by independent agency.

Maintaining communications is a staff or auxiliary service which lends itself well to extension to other jurisdictions within the primary service area. In contrast with the apprehension which seems to be generated when a metropolitan law enforcement agency offers to supply complete police service, establishment of unified, area-wide communications system is thought of as a "logical" function by many of the more suspicious guardians of police autonomy.

This seemingly contradictory interpretation has some basis. A local police department may, if it so desires, retain the ability to communicate directly with its field forces while assigning the routine dispatching burden to the central agency. This may be in fact the fundamental "selling point" in increasing the scope of central communications. Since direction and control include communication as an ingredient, all is not lost when this function is shared.

> An abstract of the significant recommendations made in surveys of sixteen major metropolitan areas completed since 1945 reveals that in a majority of cases the need for organic integration or coordination of police

> services throughout the metropolitan area has been recognized, and that in those cases where organic integration was not recommended cognizance has at least been taken of the need to consolidate certain central staff services of the police function. [12]

Awareness that exclusive control of one communications system does not meet all situations has led to an interesting development designed to partially overcome the restrictions inherent in a strictly local installation. In one area, the central system provides to certain subscribers common access to the intersystem frequency, so that broadcasts concerning the more serious incidents in a jurisdiction which might involve other departments may be placed (rebroadcast) on the local dispatching frequency. This service (for the metallic telephone line that links participants) costs $14.40 per month.

Non-subscribers to this facility have intercommunication capability, of course, since the intersystem frequency is available to all. Automatic rebroadcast, however, is not always possible. Considering the use to which this point-to-point frequency is put, it serves well as a rapid means of disseminating information

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[12]Max A. Pock, Consolidating Police Functions in Metropolitan Areas (Ann Arbor: University of Michigan Law School, 1962), p. 4.

concerning robberies and other more serious felonies, emergency weather advisories, and occasionally hot pursuits likely to cross jurisdictional lines.

Many police administrators seek similar capability, however, for the daily interagency activities which fall short of being "critical" in nature.

Included in the definition of "interagency" activities are the more routine patrol tasks such as preliminary investigations of criminal complaints and accidents occurring on or near boundaries, and followup of investigations which may involve an offense committed in one jurisdiction with suspects in another. It includes the frequent necessity to obtain subject and license checks (including registrations) from a central source without the inquiring agency. These are commonly procured through relay by radio, teletype, telephone, or combinations thereof.

It is service of this type which may best be provided by a central agency. Failure to develop and to take advantage of all communications resources available deprives field forces of a useful and sometimes vital means of accomplishing police objectives.

In determining the desirability of consolidating communications systems, several factors should be objectively examined. Included are:

1. Expenditures in personal services and inventory stocks for equipment installation and maintenance or the costs of contractual maintenance services. Consider also the availability of 24-hour maintenance.
2. The condition (value) of equipment owned, its expected life, conformance with FCC requirements, and the degree to which its capabilities are realized.
3. The costs of personal services for administration and supervision of complaint/dispatching personnel.
4. Capital improvement costs allocated to complaint/dispatching services.
5. The reliability and completeness of wanted files and other information maintained at the local level.
6. The administrative and supervisory usefulness of records compiled by communications personnel.
7. The costs of training complaint operators and dispatchers, and their level of competence.

II. CENTRALIZING "PUBLIC SAFETY" SERVICES

The Local Government Radio Service was previously described, and subsequently possible benefits of centralized maintenance. The prospect of combining or centralizing police, fire, and other "public safety" activities is thus encouraged at least from the standpoint of frequency availability.

In some municipalities, these activities are combined to the degree that dispatching takes place in the same area. Complaint/dispatch personnel, as well as switchboard operators, may normally restrict their operations to each assigned function, but help out in other functions if "overloads" occur. The National Board of Fire Underwriters may require a certain minimum personnel complement in the case of fire dispatching operations. [13]

Police control of police dispatching operations is considered essential. Providing effective communications is a matter of prime importance to police administrators. It is

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[13]National Board of Fire Underwriters, Municipal Fire Alarm Systems (New York: National Board of Fire Underwriters, 1962), p. 32.

especially recognized as vital to the success of a one-man car operation. The officer must rely to a significant extent on the ability and knowledge of the dispatcher, or on the individual supervising the dispatcher.

As has been pointed out, the dispatcher serves as the commander's voice. To the extent that direction and control are impeded, line units are less effective. In situations demanding rapid deployment or assistance, discretion is critical.

If responsibility for dispatching operations is divided, unity of command is immediately lacking. A law enforcement agency cannot adequately control operation--or assume responsibility for lack of control--unless the function is assigned to it.

CHAPTER X

SUMMARY AND CONCLUSIONS

This chapter presents the summary of findings and the conclusions that were drawn.

I. SUMMARY

Police communications systems are composed of many elements, some of which are directly controlled by external agencies such as the Federal government. The communications function is most properly a staff responsibility, since it serves all organizational units of the department. The supervision afforded must be adequate because of the demonstrated need for direction and coordination.

Processing of complaints from the initial reception to the final disposition can take many forms, as has been shown. The goal of rapid and accurate processing is achieved with minimum expenditure by combining appropriate elements to fit department needs.

Evaluating communications effectiveness may be facilitated by means of analysis of system components, supported by data generated in the operation.

An estimate of police communication trends indicates a move toward centralization of all communications services performed by a governmental entity. In some urban areas, in spite of the great number of individual systems, consideration is given to centralized control. Short of direct control, many areas both urban and rural, participate in intersystem communications networks.

II. CONCLUSIONS

It became immediately apparent in the research undertaken for this thesis that the impressive number of writings in the communications field generally did not provide sufficient tangible aid in assessing the state of any particular police communications system. The basic concept of communications between fixed points and mobile units is shared in many communications applications, but none were found to adequately correspond to the needs identified in the police service.

An example is the elaborate air traffic control system managed by the Federal Aviation Agency (FAA). All phases of the communications system were reviewed by the author through inspection and monitoring of local (airport) control, approach and departure control, and enroute control facilities in the Washington and Kansas City areas. To the extent that particular phases of the FAA's operations could be considered as corresponding to police operations, the

observations were used in arriving at evaluation criteria, but these were quite limited.

Other communications users in the Land Mobile Services offer many parallel situations and many of their problems are similar. None were found, however, with the volume of messages to be processed possessing an emergency connotation as found in the police service.

Obviously, a need for further research in this area is demonstrated. Subsequent evaluation of changes made in certain systems, as described in the case studies, has indicated that the hypothesis is valid. Well planned and supervised communications systems do contribute substantially to the accomplishment of police objectives. There remains however, a need for more precise measures of message volume, channel loading, dispatcher workload, and frequency utilization which may be readily applied.

These factors, once devised, will of course aid the police administrator in evaluating and planning communications requirements. Of perhaps even more potential significance is the application of findings in the complex field of communications which do not at present seem to lend themselves to police interests.

The communications industry produces too many innovations to permit any degree of complacency on the part of those responsible for police operations. It can only be hoped that interest in potential uses will be encouraged by this most preliminary effort.

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