AN

EMERGENCY MEDICAL SERVICES COMMUNICATIONS PLAN FOR THE STATE OF IOWA

Prepared by SPECTRA ASSOCIATES, INC. and Iowa State Department of Health, under a project approved by the Office for Planning and Programming, Division of Highway Safety, in cooperation with the U.S. Department of Transportation, National Highway Traffic Safety Administration.

spectra associates inc.
CEDAR RAPIDS, IOWA
COMMUNICATION SYSTEM SPECIALISTS

AN EMERGENCY MEDICAL SERVICES COMMUNICATIONS PLAN FOR THE STATE OF IOWA

The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the Office for Planning and Programming, Division of Highway Safety, or the National Highway Traffic Safety Administration.

Prepared for:

State of Iowa
Department of Health
Community Health Services
Des Moines, Iowa

28 February, 1973

TABLE OF CONTENTS

	TABLE OF CONTENTS	i
	LIST OF FIGURES	iv
	LIST OF TABLES	iv
	ABBREVIATIONS AND DEFINITIONS	v
	ACKNOWLEDGEMENTS	viii
		Page
SECTION 1.0	THE EMS COMMUNICATIONS SYSTEM (EMSCS)	1
	BACKGROUND	1
	FUNCTION	3
	THE APPROACH TO ACHIEVEMENT OF THE EMSCS	4
	THE SYSTEM FACILITIES ROLES	5
	REGIONAL COMMUNICATIONS	7
	HOSPITAL/AMBULANCE COMMUNICATIONS	7
	CIVIL DEFENSE	8
	LAW ENFORCEMENT/PUBLIC SAFETY	8
SECTION 2.0	REGIONAL PLANNING FOR AN EMS COMMUNICATIONS SYSTEM (EMSCS)	9
	REGIONAL BOUNDARY SELECTION CRITERIA	10
	COMM CENTER SELECTION GUIDELINES	11
	HEALTH PLANNING COUNCILS	12
	REGIONAL FACILITIES	12
	RECOMMENDED REGIONS AND COMM CENTERS	14
SECTION 2.1	SPECIFIC FACILITY SELECTION OF A REGIONAL COMM CENTER	21
	COMM CENTER REQUIREMENTS	21
	OPTIONAL COMM CENTER REQUIREMENTS	23
SECTION 2.2	SELECTION OF SPECIFIC FACILITY ROLES IN A REGIONAL PLAN	30
	FACILITY FUNCTIONS	30
SECTION 2.3	EMS COMMUNICATIONS SYSTEM (EMSCS) OPERATIONS STATEWIDE	35
SECTION 3.0	COMMUNICATIONS SYSTEM PLAN	38
SECTION 3.1	GENERAL SYSTEM REQUIREMENTS	38
3.2	SYSTEM REQUIREMENTS - SPECIFIC TERMINALS	39
3.2.1	COMM CENTERS	39
	COMM CENTER ELEMENTS	41
	RADIO SYSTEM DESIGN PARAMETERS	45
3.2.2	FACILITY DESIGN PARAMETERS	49
	HOSPITAL NON-COMM CENTER (NO RADIO BASE)	49
	HOSPITAL TERMINAL WITH RADIO BASE	49
	HOSPITAL TERMINAL - METROPOLITAN RADIO	50

		Page
SECTION 3.2.3	AMBULANCE OPERATIONS CENTERS	53
3.2.4	AMBULANCE VEHICLE	53
3.2.5	LAW ENFORCEMENT AND LOCAL GOVERNMENT	56
3.2.6	TELEPHONE SYSTEM	58
	EMS REQUEST ENTRY	58
	911 EMERGENCY REPORTING	59
	RECORDING OF EMS REQUESTS	60
	COMMON CARRIER SERVICES	61
SECTION 3.2.7	SERS FREQUENCY UTILIZATION	61
	CHANNEL DESIGNATIONS	61
	SERS FREQUENCY COORDINATION	62
	SERS FREQUENCIES BETWEEN 155.160 and 155.295 MHz	63
	SERS FREQUENCIES BETWEEN 155.325 and 155.400 MHz	65
	SERS FREQUENCIES - REGIONAL PLAN	66
	PRIVATE AMBULANCE USE OF RADIO FREQUENCIES	69
	MUTUAL AID - FIRE FREQUENCY	69
SECTION 3.2.8	RADIO PAGING	70
	EMERGENCY MEDICAL SERVICES PERSONNEL	70
	OTHER MEDICAL AND HOSPITAL PERSONNEL	70
SECTION 3.2.9	MEDICAL DATA TELEMETRY - UHF	72
SECTION 3.2.10	MESSAGE TRAFFIC CHANNEL LOADING	74
	MESSAGE TRAFFIC ANALYSIS BY REGIONS	80
SECTION 3.2.11	SELECTIVE CALLING	82
	DIGITAL DIALING	82
	TONE CODED SQUELCH	84
	AUTOMATIC MESSAGE ROUTING	86
	EMS COMMUNICATIONS DIRECTORY	86
SECTION 3.3	SYSTEM EVALUATION CRITERIA	88
	EVALUATION OF THE EMS COMMUNICATIONS SYSTEM PERFORMANCE	88
	EVALUATION OF SYSTEM RESPONSE	90
	TOTAL SYSTEM EFFECTIVENESS	92
	COST ASSESSMENT	93
SECTION 3.4	EMSCS EQUIPMENT SPECIFICATIONS	94
3.4.1	COMM CENTER BASE AND REMOTE BASE STATION SPECIFICATIONS	94
3.4.2	CONTROL CONSOLES FOR COMMUNICATIONS CENTERS	102
3.4.3	TELEPHONE SUBSYSTEM FOR COMM CENTER	107
3.4.4	TAPE RECORDER	108
3.4.5	AMBULANCE COMMUNICATIONS EQUIPMENT (SERS FREQ.)	109
3.4.6	OPTIONAL LOW BAND VHF MOBILE COMMUNICATION EQUIPMENT	112
3.4.7	REGIONAL HOSPITAL RADIO BASE STATION	114
3.4.8	EMERGENCY ROOM DESK/WALL TELEPHONE SET	117

		Page
SECTION 3.5	RADIO STATION LICENSING	119
	FOR COMM CENTERS	121
	FOR HOSPITALS	121
SECTION 3.6	OPERATOR TRAINING AND PROCEDURES	122
	DISPATCHER RESPONSIBILITIES	122
	TRAINING AND QUALIFICATIONS FOR DISPATCHER AND AMBULANCE RADIO OPERATORS	123
	OPERATIONS MANUAL	124
	PROCEDURAL SIGNALS	125
SECTION 3.7	SPECIAL SYSTEMS	129
	STATE UNIVERSITY HOSPITAL - IOWA CITY	129
	COUNCIL BLUFFS	130
SECTION 3.8	CENTRAL COMPUTER USAGE	130
SECTION 4.0	IMPLEMENTATION AND COST SUMMARY	132
	GENERAL APPROACH	132
	IMPLEMENTATION CRITERIA AND REGIONAL SELECTION	133
	SPECIFIC EMSCS EFFORT QUIRED DURING PHASED IMPLEMENTATION	139
SECTION 5.0	RECOMMENDATIONS	143
	A. ORGANIZATIONAL RECOMMENDATIONS	143
	B. OPERATIONAL PROCEDURAL RECOMMENDATIONS	144
	C. DESIGN STANDARDIZATION RECOMMENDATIONS	145
	D. EQUIPMENT RECOMMENDATIONS	145
	E. FCC FREQUENCY COORDINATION AND IOWA TARRIFF NO. 1 RECOMMENDATIONS	146
	F. PROGRAM IMPLEMENTATION RECOMMENDATIONS	148
SECTION 6.0	REFERENCES	149
	BIBLIOGRAPHIC REFERENCES	150
APPENDIX A	FCC RULES AND REGULATIONS, PART 89.525	A-1-2
APPENDIX B	FCC RULES AND REGULATIONS, PART 17,SUBPART A,B,C	B-1-2-3
APPENDIX C	DETAILED REGIONAL IMPLEMENTATION COST ESTIMATES	C-1-2

LIST OF FIGURES

		Page
FIGURE 2-1	AREAWIDE COMPREHENSIVE HEALTH PLANNING AGENCIES	13
2-2	RECOMMENDED EMSCS REGIONAL BOUNDARIES AND COMM CENTERS AND BASE STATION LOCATIONS	22
3-1	GENERIC EMS COMMUNICATIONS SYSTEM DIAGRAM	40
3-2	TELECOMMUNICATIONS SYSTEM DIAGRAM - GENERIC COMM CENTER DIAGRAMS	42
3-3	TELECOMMUNICATIONS SYSTEM DESIGN - HOSPITAL NON-COMM CENTER DIAGRAM	51
3-4	AMBULANCE OPERATIONS CENTER - NON-COMM CENTER DIA.	54
3-5	AMBULANCE COMMUNICATIONS EQUIPMENT DIAGRAM	55
3-6	LAW ENFORCEMENT AGENCY COMMUNICATIONS DIAGRAM	57
3-7	EMS REGIONAL CHANNEL ASSIGNMENTS	67
3-8	MEDICAL DATA TELEMETRY SYSTEM - UHF SERS FREQUENCIES	73
3-9	CHANNEL LOAD - SINGLE CHANNEL	75
3-10	CHANNEL LOAD - TWO CHANNEL	76
3-11	CLEAR CHANNEL WAIT TIME - ONE CHANNEL	78
3-12	CLEAR CHANNEL WAIT TIME - TWO CHANNEL	79

LIST OF TABLES

TABLE 2-0	EMS REGIONS AND COMM CENTERS	14
2-1	DECISION AID - REGIONAL COMM CENTER FACILITY SELECTION	25
2-2	DECISION AID - SPECIFIC REGIONAL COMM CENTER SELECTION	26
2-3	DECISION AID - COMM CENTER PLANNING	29
2-4	DECISION AID - SPECIFIC FACILITY ROLES IN THE REGIONAL EMSCS	32
3-1	REGIONAL COMM CENTER AND REMOTE BASE SIGNAL COVERAGE AND ANTENNA PARAMETERS	47
3-2	FCC LICENSES ISSUED IN IOWA AND WITHIN 75 MILES - SERS HIGH BAND	64
3-4	OFFICIAL APCO 10-SIGNAL LIST	126
3-5	OFFICIAL APCO 2-SIGNAL LIST	128
4-1	REGIONAL HOSPITAL BASE STATION SELECTION	134
4-2	REGIONAL EMSCS IMPLEMENTATION ESTIMATED COSTS SUMMARY	136
4-3	ESTIMATED ANNUAL EXPENDITURES FOR TOTAL REGIONAL EMSCS IMPLEMENTION COSTS	140

ABBREVIATIONS AND DEFINITIONS

Ambulance Operations Center	-	The ambulance service administrative office which will receive dispatch orders and will select EMTA's and equipment for a run.
APCO	-	Association of Public-Safety Communications Officers
CC	-	Comm Center(s)
Comm Center(s)	-	A Communications Center which receives all incoming requests for emergency medical services within a specified region and designates the ambulance to be dispatched. The Comm Center has complete capability to communicate by either radio or telephone to the various organizations (ambulances, hospitals, law enforcement, fire departments, etc.) involved in EMS.
Comm Link	-	(See telecommunications link)
Digital Dial Decoder	-	Located in the receiver, the Digital Dial Decoder circuit decodes the series of transmitted digital dial tone pulses and determines whether the transmitted signal is intended for the receiving station.
Digital Dial Encoder	-	The Digital Dial Encoder circuit generates a 1500 Hz tone which is activated by a switch on a rotary telephone type dial. The number of tone pulses corresponds to the number dialed.
Direct Communications Link	-	A telecommunications link directly connecting two or more users with no requirement for an immediate dispatcher or operator to relay messages.
DOT	-	U. S. Department of Transportation
EMS	-	Emergency Medical Service(s)
EMSCS	-	Emergency Medical Service Communications System
EMS Requests	-	Those messages requesting any type of emergency medical service involving ambulance or other rescue vehicle(s).

EMTA	-	Emergency Medical Technician - Ambulance
Emergency Operations Center (EOC)	-	The Civil Defense location in an area which is constructed and designated to provide emergency communications command and control during disasters.
ER	-	Emergency Room or department in a hospital.
Erlang	-	A fully loaded communications channel equals 1.0 Erlang. Fractional Erlang values represent the degree of loading.
FAA	-	Federal Aviation Administration
FCC	-	Federal Communications Commission
FM	-	Frequency modulation
HEW	-	U. S. Department of Health, Education and Welfare
HL	-	"Hot-Line" or dedicated telephone circuit, connecting only two specific telephones.
Hz	-	Hertz (Cycles per second)
IHP	-	Iowa Highway Patrol
IPR	-	Iowa Police Radio
IPS	-	Iowa Public Safety (Same as IPR)
LE	-	Law Enforcement
LEA	-	Law Enforcement Agency
MHz	-	Unit of radio frequency measurement meaning millions of cycles per second.
Operations Director	-	Specifically an ambulance service Operations Director.
OPP	-	Office for Planning and Programming (State of Iowa)
Phone Patch	-	A means of directly coupling two-way radio equipment to a telephone line thereby extending two-way radio communications capability to a fixed location remote to the radio equipment. Allows a radio oper-

		ator to monitor conversation and to maintain control of transmissions as required by FCC Rules and Regulations.
Radio Link	-	A communication link over which intelligence is transmitted by means of radio signals.
R/T	-	Receiver/Transmitter
SERS Frequencies	-	Special Emergency Radio Service frequencies allocated by the FCC.
Telco Call Director*	-	A desk top instrument which provides a common answering point for multiple lines terminating in the system.
Telecommunications link	-	Any communication circuit or combination of circuits which transmits intelligence from one point to another
Terminal	-	A facility at which the consoles for telephone and radio system are located and where operations are conducted.
TL	-	Telephone line, regular dial-up telephone circuit.
TRACIS	-	Traffic Records and Criminal Justice Information System (Iowa)
TCS	-	Tone Coded Squelch, an audible or subaudible tone transmitted continuously to activate the audio section of a receiver, thereby allowing the listener to hear the message that follows. Otherwise the receiver remains quiet until the correct tone is transmitted.
UHF	-	Ultra high frequency radio frequency band which covers 300 to 3000 MHz.
VHF	-	Very high frequency radio frequency band which covers 30 to 300 MHz.
VHF Low-Band	-	VHF frequency band, 30 to 50 MHz.
VHF High-Band	-	VHF frequency band, 150 to 174 MHz.
	-	Symbol meaning "greater than".
	-	Symbol meaning "less than".
VOX	-	Voice Operated Transmitter

* Bell system trademark.

ACKNOWLEDGEMENTS

SPECTRA ASSOCIATES, INC. expresses appreciation to all those who provided guidance, information and assistance during the course of this program. The effort of hospital and ambulance administrators who gave time and information during the survey was of great value.

We express special gratitude for the guidance and perspective of Program Manager, Dr. Ronald D. Eckoff, Chief, Community Health Service. Everyone serving on the EMS Communications Task Force, through their interactive participation made a great contribution to the program development.

1.0 THE EMS COMMUNICATION SYSTEM

BACKGROUND

A quotation from the Highway Safety Programs Standard dated June 27, 1967 for emergency medical services states, "Many of those injured in highway accidents die needlessly or are permanently disabled because they do not receive prompt and proper emergency care. Few areas of the United States now have adequate emergency services. In most areas, there has been inadequate planning of emergency logistics, communications and transportation facilities and present services are inadequately managed .... Hospitals and ambulances seldom have radio or other direct communications links either to each other or to police radio communication systems .... It is imperative that Highway and other emergency services be improved throughout the nation."

Many people in Iowa have become increasingly aware of the need to reduce the serious injury and fatalities which result from accidents. As a result of this concern efforts are being made to improve emergency medical services so that accidents can be easily reported and prompt emergency medical care provided to the victims. In 1971 Governor Ray appointed an Emergency Medical Services (EMS) Advisory Council for the purpose of developing and guiding improvements to the emergency medical services (EMS) system in Iowa. The State Office for Planning and Programming and the State Department of Health, in cooperation with other Departments of State government, and the U. S. Department of Transportation have acted in cooperation with the EMS Council to strengthen Iowa emergency medical services.

The development of an economical, comprehensive statewide communications plan was recognized to be necessary by the EMS Advisory Council. The Council acted by employing SPECTRA ASSOCIATES, INC., an Iowa based firm of communication system specialists, to perform an in-depth study of the present Iowa EMS system and in cooperation with the EMS Advisory Council, to develop a detailed EMS communications plan for implementation in Iowa. The study was financed in whole through a Highway Safety Act grant from

the U. S. Department of Transportation. The resulting plan, when implemented, will provide the State of Iowa with a coordinated statewide integrated communication system which eliminates deficiencies known to exist in the present system, and provides a firm basis for future system growth.

This report presents the final Iowa EMS plan and is directed to the state and local government officials, hospital administrators and others who are interested in and are responsible for providing all or portions of a comprehensive communications system for emergency medical services in the State of Iowa.

It is clear that there are certain fundamental features or capabilities which are necessary to enable an effective EMS communication system. The features include:

1. Public awareness of the EMS plan and a uniform statewide method by which anyone may summon help.
2. Immediate dispatch of the closest capable ambulance and rescue vehicles.
3. Transmission of patient condition and receipt of care information prior to and during his transfer to a hospital.

As a result a competent EMS communication system must provide the means to:

1. Report requests for emergency service to a regional emergency Comm Center.
2. Allow communications between emergency Comm Centers and ambulance operations centers.
3. Allow communications between mobile ambulance technicians and medical personnel at the receiving hospital emergency room to provide patient vital sign information and to provide direction for patient stabilization.
4. Allow communications between the ambulance attendants and law enforcement personnel.

Therefore, the question, "What is an EMS Communications System (EMSCS)"

may be answered in summary by stating, "It is an emergency medical service telecommunications system providing a central terminus for accepting individual emergency requests and to summon appropriate ambulance and/or rescue facilities; for providing the radio or common carrier links between the Comm Center, ambulances, hospitals and their emergency rooms to include the medical attendants and public safety and local government agencies; and to provide a rapid and cost effective flow of emergency medical information".

FUNCTION

The EMSCS begins to function when an individual reports either the need for medical aid or that an accident has occurred. The function ends with delivery of the patient to a hospital which has appropriate emergency medical capabilities. Within the period of time encompassed by these two events, an EMSCS in a region or community should be capable of providing a timely and efficient response by means of the following:

1. A single, well known telephone number at a Comm Center for receiving EMS requests.
2. A single authority (Comm Center) dispatcher responsible for efficient action in handling EMS requests on a regional (multiple-county basis).
3. A central dispatch authority (Comm Center) for coordinating ambulance and rescue vehicle activity throughout a region.
4. A communications network capable of providing direct communications links between hospitals, ambulance vehicles and rescue units (including helicopter ambulances, law enforcement, ambulance service, doctors, fire departments, wrecker services, etc.). These required EMSCS capabilities are shown by Figure 3-1.

In many Iowa communities several of the required communication links (Reference Figure 3-1) and capabilities do not currently exist and consequently emergency medical services are not supplied as rapidly or as effectively as possible. A few facts concerning the status of the EMS communications in Iowa will lend perspective to the application of this report.

Private citizens initiate directly 40% of the emergency requests for ambulance service. The method used to request ambulance services differs widely from one community to another. There is not a standard method for summoning the required services and thus assure uniform efficiency in patient delivery to medical facilities. There is an experimental highway emergency reporting system (HELP) now being tested by the Iowa Highway Patrol which makes possible a ready access to ambulance and rescue assistance for those traveling the interstate and on the primary highways. Over one half of the communities with emergency medical service radio communications make use of local police, fire, or sheriff's radio dispatch facilities and many requests for service are received by these agencies. The radio equipment employed in many ambulances is equipment loaned by local municipal and county organizations.

Only 16% of the hospitals in the State of Iowa have radio communications between their emergency facilities and the ambulance vehicles serving them. Hospital administrators and ambulance service managers recognize the great need for direct communication between the ambulance vehicle and the hospital emergency room. There are no regional EMS communications centers established.

THE APPROACH TO ACHIEVEMENT OF THE EMSCS

The intent of this report is to provide the approach and the necessary information for the construction and operations of a system which has statewide, regional, and local applications. The system recommendations were developed in two EMS Interim Reports (References 4 and 5).

In order to assist in the EMSCS implementation, the report provides:

- Recommendations and decision guidelines for establishing regional boundaries and Comm Center locations.
- Identification of State agencies and regional planning groups who can provide planning assistance and who should cooperate in decision making.
- Development of general EMSCS requirements and standards
- Detailed equipment lists and specifications for the terminals and communications links of the system.

The primary objective of this study is to provide a plan for implementing a communications system to be broadly effective to improve emergency medical services across the State of Iowa and beyond its border. There must be a major improvement in:

- The methods available for requesting ambulance and rescue services statewide.
- Providing radio equipment in ambulance and rescue vehicles to allow communications between the vehicle and central dispatch to hospital emergency room, and to law enforcement/public safety mobile units.
- Providing regional Comm Centers to dispatch and coordinate emergency services such as intensive care, bloodbank and specialists skills within a larger area than local communities and counties.
- Allowing disaster communications which must relate medical services to the Civil Defense emergency preparedness plans and to provide reliable point-to-point radio links between medical facilities when telephone lines are inoperative.

THE SYSTEM FACILITIES ROLES

Figure 3-1 diagrams the basic EMSCS functions. The terminal facilities and interconnecting links of the communications system are shown in terms of the Comm Center, the medical facilities, the ambulance vehicles and operations center, and the local government services.

A properly functioning EMSCS has a central communications terminal (Comm Center) for receiving the EMS requests arriving from any location in the region. This allows citizens to request assistance and allows the public and private agencies to report that an emergency exists in which victims need treatment.

The Comm Center dispatcher must be able to communicate quickly and directly with an ambulance operations center, with ambulance and rescue vehicles and with hospital emergency rooms. The Comm Center dispatcher must have at his disposal an inventory record file of regional ambulance and rescue units. This file should include ambulance locations and their respective effective

response areas, availability, and capability for handling various specialized emergency situations. This information is necessary to select and to route only the required number of qualified ambulance vehicle(s) and rescue vehicle(s) to the emergency scene. The dispatcher also must be able to communicate readily with various government services within a region for there are many activities provided by the law enforcement, fire department and other public facility agencies which need to be drawn upon in various kinds of emergencies.

The Comm Center must have a communications link to each hospital in the region to alert the emergency room and to secure assistance. Also, the Comm Center must be able to communicate continuously with ambulances throughout the region and provide current information and directions to them as they transport patients.

The EMSCS provides a direct communication path for voice, and is optionally implementable for medical data telemetry, from the ambulance directly to hospital emergency room personnel or from the ambulance through the Comm Center to hospital emergency personnel. Paging of emergency personnel is an important adjunct to the EMSCS, however, administrative paging must not occur on these links.

The Comm Center acts as a command and control center for the operation of the regional emergency medical services communications. All emergency medical communications within the region either pass through the Comm Center or are monitored by the dispatcher.

The Comm Center location is important. It has a central role in initiating emergency communications. It is most economical when designed to function in a multi-county region and to interface with other telecommunication networks in that region. For practical purposes, radio communication may be considered to be restricted to line-of-sight communication paths from the Comm Center to ambulance mobiles and to law enforcement and local government mobiles which are at or near the scene of the accident. A Comm Center may be sited at various locations in a region:

- Within a major hospital facility in that region.
- At a local government communications dispatch center.
- At a regional ambulance service.

The Comm Center should have a capability for communicating with the Comm Centers of other regions. In this way statewide EMS communication links can be made with local, public, and private agencies and to major medical and public safety centers, thus becoming an integrated system serving the entire state with maximum effectiveness.

REGIONAL COMMUNICATIONS

The Comm Center dispatcher is responsible in each emergency situation for accurate and rapid decisions. He must have a precise knowledge of all capabilities for emergency assistance in the region. He must be capable of utilizing the EMSCS to secure the assistance appropriate to the situation.

In some regions the EMSCS operator's control console, receiver/transmitter, and antenna are located at the same site. In certain other regions the radio base station may be located physically at a different site than the Comm Center in order to achieve adequate radio signal. In other regions a secondary or remote controlled radio system is required to augment the primary radio base station for obtaining regional signal coverage reliability and to enable the ambulance vehicles to communicate with the Comm Center.

Communications between regional Comm Centers will normally occur through telephone circuits or, under disaster conditions, by means of point-to-point radio channels. The latter should be utilized during disaster or major emergency periods in cooperation with Civil Defense emergency plans.

HOSPITAL/AMBULANCE COMMUNICATIONS

A most important communication system function is to provide an assured link between the ambulance and the hospital emergency room personnel. Patient symptoms and vital signs may be monitored and reported by Emergency Medical Technician - Ambulance (EMTA's) so that the receiving emergency facilities will be prepared for the situation. This link also can

be used to convey instructions and medical advice to ambulance personnel.

CIVIL DEFENSE

The EMSCS utilizes telephone links as the primary communication media with hospitals in the region. It also has the capability for utilizing point-to-point radio links. At times of major emergencies and disasters during which time the telephone lines are disrupted, the less vulnerable radio links are invaluable.

It is recommended that cooperative planning be carried out between Civil Defense and the EMSCS planning authorities to assure that the EMSCS radio facilities are available for use in the Civil Defense disaster preparedness plans and that these plans be tested periodically.

LAW ENFORCEMENT/PUBLIC SAFETY

Law enforcement and public safety personnel discover and become involved with many of the emergency situations which require medical assistance. The ability to interlink these agencies with the EMSCS allows the dispatcher to coordinate necessary activities such as

- to summon ambulance and rescue units,
- to obtain and relate precise locations,
- to obtain interim medical personnel consultation,
- to perform other communication functions important to public safety.

These linkages can readily be developed by providing a communication link between the Comm Center and various law enforcement agencies. The interlinkage is further enhanced by providing a common mutual aid radio channel in the vehicles of all interlinked agencies.

2.0 REGIONAL PLANNING FOR AN EMS COMMUNICATIONS SYSTEM (EMSCS)

EMS communications must be planned on a regional basis to avoid the development of too many Comm Centers, the purchase of excessive equipment, and inordinate expenditures of manpower for installation, operation, and maintenance. Further, the planned development of regional EMSCS leads naturally to an efficient linkage between regions and thus forms a statewide capability for communication between regional Comm Centers, ambulances, hospitals, and law enforcement and public safety agencies.

The primary activity in the development of an integral EMSCS is to determine the geographical size and number of subdivisions of each of the various EMS regions which are to be established in the State. In any one possible EMS region there are, in general, several communities with one or more hospitals, each having varying care capabilities. In addition, there are several ambulance services available for patient transfer to these hospitals.

Regional boundaries should include medical facilities and services which normally serve and plan cooperatively. A region should also include a service area which has an ability and willingness to support an EMS Comm Center. The area should not be so great, however, as to require radio propagation beyond line-of-sight distances. Ambulance travel range must be considered because their response time is dependent on distance.

This report presents a communications plan for statewide EMSCS implementation. The described system will require cooperative effort between several agencies in each region to assure satisfactory operation. Many persons and groups will be instrumental to the success of the EMSCS, including:

- Local Medical Facility Administrators
- Regional Health Planning Councils,
- Iowa Hospital Association,
- EMS Advisory Council and Task Forces
- EMS Section of the Department of Health
- State Director of Communications
- Public Safety Personnel

Specific functional responsibilities are suggested for these groups.

REGIONAL BOUNDARY SELECTION CRITERIA

The planning of regional boundaries for emergency medical services and the establishment of a regional Comm Center can best be accomplished when clear selection criteria are established and followed. The criteria used for the boundary selections of this report are summarized as follows:

1. A regional health planning committee is functioning or being organized which can assist planning efforts for each EMS region in the state and which is comprised of representatives of all or a majority of the participating facilities within the region. This group can provide assistance in regional facility selection, provide cooperation in financing, equipping, and operating regional facilities and can provide an emergency coordinator for operational decision making. This individual should play a leading role in the cooperative EMS planning within the region and with adjacent regions, and for assisting with state and federal EMS program activities. It is recommended that the established health planning councils assume a major role in regional coordination.
2. An existing facility may be selected as a Comm Center for each region. This facility may be either a hospital, a municipal or county law enforcement center, a fire department communications center, or it may be an ambulance operations center. The selected facility must be willing to assume responsibility for regional EMSCS operations. The center should be centrally located although this requirement may be relaxed because of higher priority selection factors.
3. A principal hospital is located in the region or in an adjacent region. This hospital should have a major emergency care facility and the requisite medical staff for advising the Comm Center dispatcher and ambulance team as needed.
4. A county grouping providing an operational communications range not to exceed thirty (30) to thirty five (35) miles from center to edge. This distance allows for effective radio communication to mobile units from a central base station. To meet other criteria,

remote base stations are permitted to avoid the need for excessive transmitter power and antenna heights.

5. A regional boundary which generally includes the normal radius of service of the hospitals within the region. (Reference 5, page 38)

6. A selection of boundaries which will improve the cost-benefit relationship for the entire statewide system.

COMM CENTER SELECTION GUIDELINES

To implement an EMS regional Comm Center requires the close coordination, cooperation and planning involving several segments of the medical profession, hospitals, and governmental agencies at city, county and state levels within the regional health planning council area. Implementation planning must consider factors of cost, responsibility for meeting requirement criteria, and for the future expansion of operations when greater demands are placed on the communications system.

The development of a regional facility to provide adequate EMS communie cations can be most economically achieved by using existing facilities. However, in terms of a region having little or no present EMS communications, the Comm Center facility choices in order of preference and recognizing present and future activity become:

1. Hospitals having hospital-based ambulance services.
2. Area hospitals having a strong emergency medical capability and an ability to provide an EMS Comm Center which can meet a regional requirement.
3. Local government agencies through which cooperative use of facilities may be provided by law enforcement, fire departments, ambulance rescue services, and hospitals, to achieve an integrated usage of communications equipment and dispatch personnel in serving a regional EMS community.
4. Private or public ambulance operations having the size and distribution of services allowing them to provide the Comm Center function.

In several Iowa communities the hospitals represented within the recommended regional boundaries probably have insufficient emergency traffic to justify location of the EMS communications system therein. Establishing an EMS Comm Center in one of these community hospitals could result in a marginal performance, while if the EMSCS were merged with a law enforcement and fire communications center, the operational capability for each agency would improve and the economy resulting from this cooperative effort, would be increased.

HEALTH PLANNING COUNCILS

There are regional health planning councils/committees now in various stages of plan development. The regions in which they are presently active are shown on the Iowa map, Figure 2-1. These councils can be a valuable asset in the development of a statewide communications system and to the other EMS functions required to meet the health and trauma care standards of today and tomorrow.

There is a proposed organizational structure for providing health services and medical care in the State of Iowa which has recently been issued. The planning was sponsored by the Iowa Comprehensive Health Planning Council (Reference 2). Areawide planning is being developed, funded and approved by the Office for Planning and Programming of the State of Iowa. (Reference 13) The formation and activity of these councils indicates a great interest and need for such planning activity to improve medical services in Iowa.

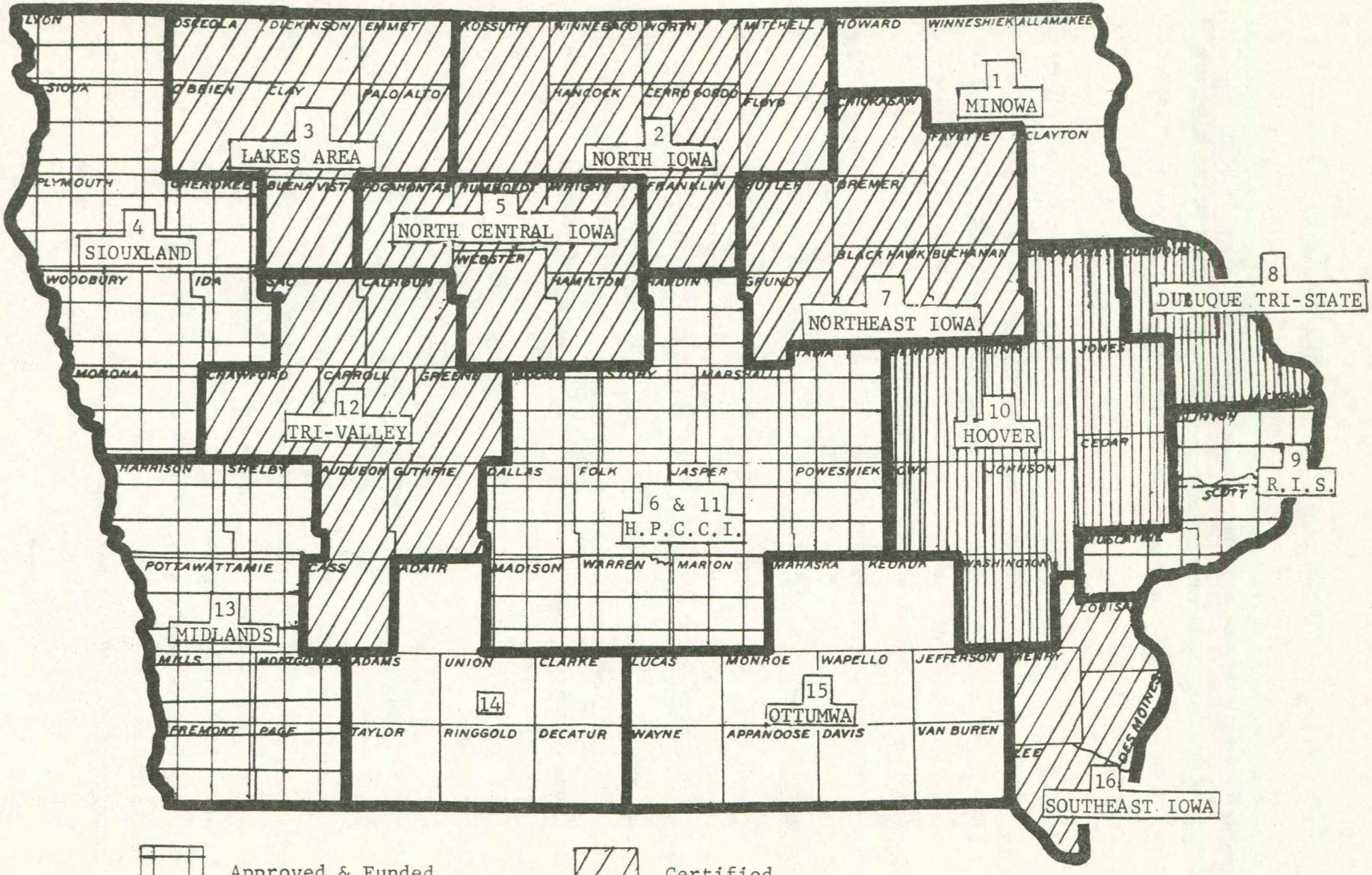
To obtain current information about the organizational status of the council in a particular area (region) and the name of a local contact, call the State Office of Health Planning,(515) 281-5675.

REGIONAL FACILITIES

In applying the foregoing criteria to develop recommended regional boundaries, an overall criterion is to recognize and consider existing regional

AREAWIDE COMPREHENSIVE HEALTH PLANNING AGENCIES

FIGURE 2-1



CP-14607

STATE OF IOWA
OFFICE FOR PLANNING AND PROGRAMMING
523 EAST 12th STREET
DES MOINES, IOWA 50319

plans which will allow meeting primary selection criteria.

There are certain county assignments into EMS regions recommended by this plan which are not those specifically shown in the plans of Reference 2 and 13. Changes in EMS county assignments are justified on the basis of the foregoing criteria.

As the EMSCS is implemented, changes in the recommended regional boundaries may be justified based on new information, changes in facilities, and upon a revaluation of planning criteria. These changes will require modifications in the communication plan and must be coordinated through the Office of the State Director of Communications.

RECOMMENDED REGIONS AND COMM CENTERS

The regional boundaries shown in Figure 2-2 are in accordance with but are not identical with the Office for Planning and Programming (OPP) areawide health planning as reported in Reference 13 which lists the counties comprising the regions, the associated health planning councils, the Comm Center location, and the nearest major medical center(s) to which major trauma activity would be directed if it were not possible to provide adequate service in the region.

TABLE 2-0 EMS REGIONS AND COMM CENTERS

REGION 1:

Counties:	Howard, Winneshiek, Allamakee, Clayton
Health Planning Council:	Minowa Health Planning Council
Major Medical Center(s):	Rochester,Minnesota; Dubuque, Iowa
Comm Center Location:	Decorah
Remote Radio Base Location:	Elkader

Comment: A local radio base station operates from a site near Decorah and above the elevation of the city.

REGION 2:

Counties:	Kossuth, Winnebago, Hancock, Worth, Cerro Gordo, Franklin, Mitchell, Floyd
Health Planning Council:	North Iowa Health Planning Council
Major Medical Center:	Mason City
Comm Center Location:	Mason City
Remote Radio Base Location:	Woden in Hancock County

Comment: A local radio base station operates from a Mason City site.

REGION 3:

Counties:	Dickinson, Clay, Emmet, Palo Alto
Health Planning Council:	Lakes Area Health Planning Council
Major Medical Center(s):	Fort Dodge, Sioux City
Comm Center Location:	Spencer or Emmetsburg
Remote Radio Base Location:	Near the joint boundaries of the four counties

Comments: The regional boundaries are not identical to those of the OPP Plan for the following reasons:

1. The Siouxland Health Planning Council now includes Osceola and O'Brien Counties.
2. It is desirable for radio propagation reasons to include Buena Vista County in Region 6 to alleviate necessity for a second remote base in Region 3.
3. A planning committee decision is required to determine the most suitable Comm Center location.

REGION 4:

Counties:	Lyon, Sioux, Osceola, O'Brien
Health Planning Council:	Siouxland Health Planning Council
Major Medical Center:	Sioux City
Comm Center Location:	Sheldon
Remote Radio Base Location:	Near Boydon

Comment: Osceola and O'Brien Counties have already been included in the Siouxland Health Planning Council boundaries per the available planning information. Reference 1.

REGION 5:

Counties:	Plymouth, Cherokee, Woodbury, Ida, Monona
Health Planning Council:	Siouxland Health Planning Council
Major Medical Center:	Sioux City
Comm Center Location:	Sioux City
Remote Radio Base Location:	One on the joint county boundaries between Cherokee and Ida Counties, another at Onawa in Monona County.

Comment: A local radio base station operates from the Sioux City site.

REGION 6:

Counties:	Buena Vista, Pocahontas, Sac, Calhoun
Health Planning Council:	Health Planning Council of North Central Iowa
Major Medical Center:	Fort Dodge
Comm Center Location:	Storm Lake
Remote Radio Base Location:	Near Varina

Comment: If Buena Vista County were to remain in the Lakes Area, another remote base station would be required. The Regions 6 and 7 are now geometrically amenable to effective radio communications.

REGION 7:

Counties:	Humboldt, Wright, Webster, Hamilton
Health Planning Council:	North Central Iowa Health Planning Council
Major Medical Center:	Fort Dodge
Comm Center Location:	Fort Dodge
Remote Radio Base Location:	Near intersection of the Wright, Hamilton and Webster County boundaries.

Comment: This county selection provides a boundary which is more amenable to radio communications and avoids a second remote base station in or near Pocahontas County.

REGION 8:

Counties:	Chickasaw, Butler, Bremer, Fayette, Grundy, Blackhawk, Buchanan
Health Planning Council:	Northeast Iowa Health Facilities Planning Council
Major Medical Center(s):	Waterloo/Cedar Falls
Comm Center Location:	Waterloo/Cedar Falls
Remote Radio Base Location:	Near Denver in Bremer County

REGION 9:

Counties:	Delaware, Dubuque, Jackson
Health Planning Council:	Dubuque Tri-State Health Planning Facilities Committee
Major Medical Center:	Dubuque
Comm Center Location:	Dubuque
Remote Radio Base Location:	West of Dubuque (approximately four(4) miles near Asbury)

Comments: (1) The Comm Center is at Dubuque and a remote base site must be selected to serve the proposed region. This location can provide radio signal propagation into Grant County, Wisconsin and Jo Daviess County, Illinois.

(2) For economic reasons and for communications and transportation effectiveness, it is recommended that Delaware County be included in this region instead of in Region 11

REGION 10:

Counties:	Clinton, Scott, Muscatine
Health Planning Council:	Rock Island Scott Health Planning Council
Major Medical Center:	Davenport
Comm Center Location:	Davenport
Remote Radio Base Location:	None

Comment: A local base station operates from the Davenport site.

REGION 11:

Counties:	Benton, Linn, Jones, Iowa, Johnson, Cedar, Washington
Health Planning Council:	Hoover Health Planning Council
Major Medical Center(s):	Cedar Rapids, Iowa City
Comm Center Location:	Cedar Rapids, Iowa City
Remote Radio Base Location:	None

Comments: The State University Hospital facilities in Iowa City serve special functions for the entire State and are discussed in Section 3.7. A separate base station installation, to effectively handle these special functions, would serve as the Comm Center for Johnson and Washington Counties in Region 11.

REGION 12:

Counties:	Hardin, Marshall, Tama, Poweshiek
Health Planning Council:	Health Planning Council of Central Iowa
Major Medical Center(s):	Des Moines, Cedar Falls/Waterloo
Comm Center Location:	Marshalltown
Remote Radio Base Location:	None

Comment: A local base station operates from the Marshalltown site.

REGION 13:

Counties:	Boone, Story, Dallas, Polk, Jasper, Madison, Warren, Marion
Health Planning Council:	Health Planning Council of Central Iowa
Major Medical Center:	Des Moines
Comm Center Location:	Des Moines
Remote Radio Base Location:	Approximately eight (8) miles north of Des Moines (near Bondurant)

REGION 14:

Counties:	Audubon, Cass, Guthrie, Adair
Health Planning Council:	Tri-Valley Health Planning Council
Major Medical Center:	Council Bluffs
Comm Center Location:	Atlantic
Remote Radio Base Location:	County line intersections near Adair

Comment: This arrangement provides a regular shaped region and eliminates the need for an additional remote base to cover Adair County if it were in Region 17.

REGION 15:

Counties:	Crawford, Carroll, Green
Health Planning Council:	Tri-Valley Health Planning Council
Major Medical Center(s):	Sioux City, Fort Dodge
Comm Center Location:	Carroll
Remote Radio Base Location:	None

Comment: This county selection provides a central regional Comm Center and reliable communications is obtained from the Carroll local radio base station.

REGION 16:

Counties:	Harrison, Shelby, Pottawattamie, Mills, Montgomery, Fremont, Page
Health Planning Council:	Health Planning Council of the Mid-Lands
Major Medical Center:	Council Bluffs
Comm Center Location:	Council Bluffs
Remote Radio Base Location:	One in Shelby County near Portsmouth, another in Fremont County near Imogene.

Comment: (1) A local radio base station operates at Council Bluffs.

(2) A telecommunications link must be established with the EMS in Omaha, Nebraska

REGION 17:

Counties:	Adams, Union, Clark, Taylor, Ringgold, Decatur
Health Planning Council:	Area 14 Health Planning
Major Medical Center(s):	Des Moines, Council Bluffs
Comm Center Location:	Creston
Remote Radio Base Location:	Between the joint county lines of Union and Ringgold, near Shannon City.

Comments: Several hospital emergency facilities serve the region. There is an affinity to Des Moines in the eastern section and to Council Bluffs in the western section which provides a sufficient capability for major EMS requirements. Communications linkages from the Comm Center in Creston must exist for triage and decision making between Des Moines and Council Bluffs.

REGION 18:

Counties:	Lucas, Monroe, Wayne and Appanoose
Health Planning Council:	Ottumwa Health Planning Council
Major Medical Center:	Des Moines
Comm Center Location:	Chariton
Remote Radio Base Location:	None

Comment: A local radio base station operates from the Chariton site.

REGION 19:

Counties:	Mahaska, Keokuk, Wapello, Jefferson, Davis, Van Buren
Health Planning Council:	Ottumwa Health Planning Council
Major Medical Center:	Des Moines
Comm Center Location:	Ottumwa
Remote Radio Base Location:	None

Comments: (1) A local radio base station operates from the Ottumwa site.

(2) There will be overlap between the Region 18 and 19 communications service. This is not undesirable providing the interference level can be minimized through cooperative activities of the two Comm Centers.

REGION 20:

Counties:	Louisa, Henry, Des Moines, Lee
Health Planning Council:	Southeast Iowa Planning Council
Major Medical Center(s):	Burlington, Iowa City
Comm Center Location:	Burlington
Remote Radio Base Location:	On a high site near West Burlington

2.1 SPECIFIC FACILITY SELECTION OF A REGIONAL COMM CENTER

Recommended EMS regions, counties comprising the regions, and Comm Center locations are shown in Figure 2-2. A responsibility faced by a Regional Health Planning Council is to recommend to the EMS Committee Advisory Task Force a specific facility where the Comm Center may be installed at this location. The Comm Center can be located in a hospital with or without ambulance service, in a law enforcement facility, in a combination of law enforcement and local government services, such as a fire department having a rescue squad, or it can be located in an area ambulance service.

COMM CENTER REQUIREMENTS

The Comm Centers of the integrated EMSCS regardless of the facility chosen must provide and be responsible for the following:

1. A central communications terminal for receiving the community/regional emergency requests and for dispatching emergency ambulance and rescue units. The dispatch position must be manned twenty four (24) hours per day.
2. Responsibility for providing efficient regional EMS command and control functions via two-way radio and telephone links to the ambulance services and to ambulance/rescue vehicle radio operators, to participating hospital emergency departments, to law enforcement dispatch, thence to law enforcement vehicles and for information transfer between the regional Comm Center and Comm Centers in other regions.

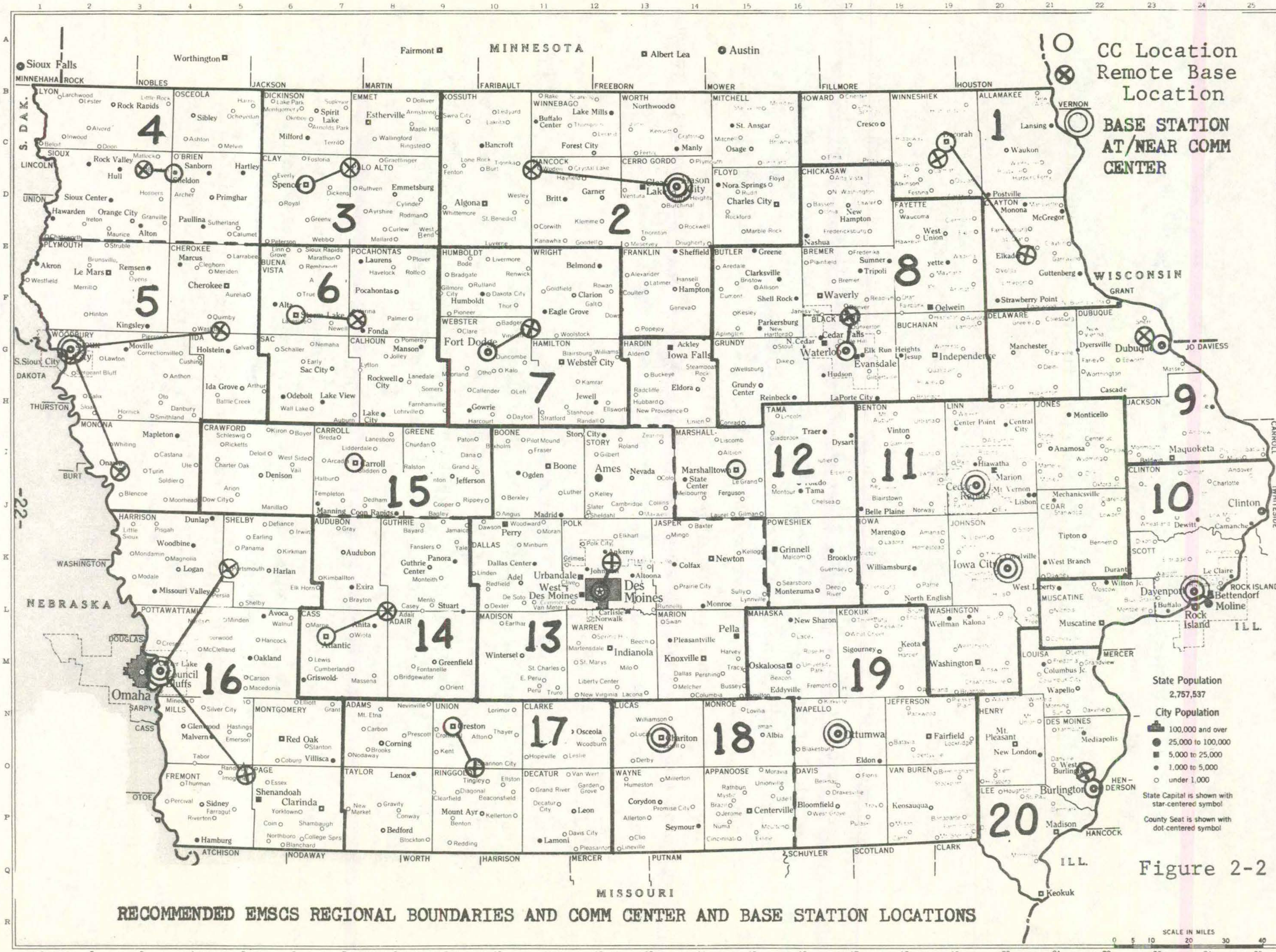


Figure 2-2

RECOMMENDED EMSCS REGIONAL BOUNDARIES AND COMM CENTER AND BASE STATION LOCATIONS

IOWA

3. Providing a tape recording of messages for reference and playback.
4. Establishment, use and maintenance of files containing information regarding location, status and inventory of the capabilities and availability of ambulance vehicles, rescue units and hospital emergency facilities and personnel.
5. A capability for paging of EMTA and other emergency medical personnel, using Special Emergency Radio Services (SERS) frequency Channel A (155.340 MHz) in the area surrounding the EMS Comm Center and from the remote radio base stations. This paging must not include administrative paging nor include more than ten (10) different emergency paging codes due to potential interference with emergency priority traffic. Paging must be performed by the Comm Center dispatcher.

OPTIONAL COMM CENTER REQUIREMENTS

1. The Comm Centers should have expandability to add a computer based accident/address location and routing system appropriate to the EMS area being served. This instant retrieval, locating/routing system must be continually updated through contact with public safety/street/road/highway maintenance units in order that it contain the latest road and bridge conditions/restrictions. These data and those discussed in (4) above could, in the future, be retained in an expanded version of TRACIS. (See Section 3.8)
2. At a future time in the Comm Centers of large metropolitan areas, it may be desirable to provide automatic dispatch control of the several telecommunications links controlled by the Comm Centers. This would provide direct dial-through and data access between ambulance vehicle operators to specific hospital emergency rooms. (See Section 3.2.11)

A very important decision to be made in EMSCS regional planning is in the selection of the specific facility for the EMS Comm Center. Installation, operation and maintenance costs can be greatly reduced if existing fa-

cilities and operating personnel can be shared. This decision can be made best by a selection group familiar with all communications facilities in the region to be covered by the recommended EMS Comm Center.

Fortunate communities which have started the development of an EMSCS using the VHF high-band SERS channels will experience reduced system upgrade costs. There are cost savings in using operational personnel of an existing radio and Comm Center. Fewer equipments will be required in a region where the Comm Center is selected near the geographical midpoint of the region, however, in meeting the criteria and guidelines this is not always possible. As a consequence this report provides recommendations for several remote radio bases operated from Comm Centers.

Planning and decision making are speeded when questions pertaining to planning can be answered "yes" or "no" and on the basis of these simple answers take a direct course of action. The following list of Regional Comm Center selection key questions is provided in the form of a Decision Table to aid the user to find an action recommendation. It is written for use by facility managers/administrators and by government officials who may be searching for or aiding in the search for a specific Comm Center location. It does not necessarily include <u>all</u> decision making steps. <u>It is recommended</u> that the following decision aid be used to guide any planning action which is directed at the facility and site selection of a Regional EMS Comm Center.

TABLE 2-1 DECISION AID - REGIONAL COMM CENTER FACILITY SELECTION

Action if Answer is "NO"	QUESTION	Action if Answer is "YES"
Review this report to determine the region in which your facility or community exists. Check with the EMS Section of the Department of Health for informataion. Telephone (515) 281-3397.	Is there a plan to install the EMSCS in this region?	Determine the status of implementation from the EMS Section of the Department of Health (515) 281-3397.
Assess your facilities for regional capabilities in terms of guidelines in this report. See page 21.	Are there regional plans for a Comm Center?	Determine the relationship of your facility to the plan. See Section 2.2 and Table 2-0.

TABLE 2-2 DECISION AID - SPECIFIC REGIONAL COMM CENTER SELECTION

Action if Answer is "NO"	QUESTION	Action if Answer is "YES"
Find a facility nearby. Determine all pertinent information about its capability and obtain EMS Advisory Committee guidance.	Is there at the Comm Center location shown in Table 2-1, a facility having communications center operations meeting similar guidelines?	Use requirements from Section 3.2 in the assessment of adequacy and the costs for required upgrading to include the EMS command/control communications. If the existing facility is selected as a Comm Center, develop specific plans based upon the Communication Plan of this report. If the sufficient facility is not selected, proceed with Decision Aid entries.
FACILITY: HOSPITAL WITH AMBULANCE SERVICE		
Seek another facility which may assume role.	Will a hospital assume the Comm Center role?	Evaluate the hospital's capability and willingness to assume Comm Center responsibility.
Seek the most effective facility in the region.	Is there another hospital having a similar interest and capability to assume responsibility for the EMS Comm Center operation?	Compare capabilities and select the preferred facility after consultation with the EMS Advisory Council.

TABLE 2-2 (Continued) DECISION AID - SPECIFIC REGIONAL COMM CENTER SELECTION

Action if Answer is "NO"	QUESTION	Action if Answer is "YES"
FACILITY: HOSPITAL WITHOUT AMBULANCE SERVICE		
Seek another facility which could assume role.	Will this hospital assume the role of Comm Center?	Evaluate the hospital's capability and willingness to assume Comm Center responsibility.
Seek the most effective facility in the region.	Is there another hospital having a capability and interest who will assume the Comm Center operations responsibility?	Compare the capabilities and select the preferred facility after consultation with the EMS Advisory Council.
FACILITY: PRIVATE OR PUBLIC AMBULANCE OPERATION		
Seek another facility which may assume role.	Will this ambulance service assume the responsibility for meeting the regional communications requirements?	Evaluate the ambulance service capability and willingness to assume Comm Center responsibility.
Seek the most effective facility in the region.	Is there another possible ambulance facility having a similar capability and interest?	Compare the capabilities and select the preferred facility after consultation with the EMS Advisory Council.

TABLE 2-2 (Continued) DECISION AID - SPECIFIC REGIONAL COMM CENTER SELECTION

Action if Answer is "NO"	QUESTION	Action if Answer is "YES"
FACILITY: LOCAL GOVERNMENT AGENCY		
Seek the most effective facility in the region.	Will the local government agency assume a responsibility for meet-the regional EMS Comm Center requirements?	Evaluate and assure the capability for dispatch of regional communications and the priority to be accorded EMS communications between hospital emergency rooms, ambulance services, and this Comm Center. (Assure that it will meet all guidelines.)
Seek the most effective facility in the region.	Is there another local government agency in the vicinity having a similar capability who would assume responsibility for the Comm Center operation?	Compare the capabilities and select the preferred agency after consultation with public safety and local government officials and the EMS Advisory Council.

Assume at this point in the decision process that the Comm Center specific location has been determined. The next activity toward implementation involves planning and completion of specific equipment selection, including its installation and the development of interconnecting links between participating facilities.

The following Decidion Aids direct planners to specific sections in the Communication Plan of this document for guidance.

TABLE 2-3 DECISION AID - COMM CENTER PLANNING

Action if Answer is "NO"	QUESTION	Action if Answer is "YES"
Find the question category pertaining to management designation for the regional Comm Center.	Is the Comm Center managed by a law enforcement agency?	Plan application for equipment, license, financial assistance and installation. Review Section 3.2.1 for equipment recommendations.
Find the question category pertaining to management designation for the regional Comm Center.	Is the Comm Center managed by a fire department?	Plan application for equipment, license, financial assistance and installation. Review Section 3.2.1 for equipment recommendations.
Find the question category pertaining to management designation for the regional Comm Center.	Is the Comm Center managed by a hospital?	Plan application for equipment, license, financial assistance and installation. Review Section 3.2.1 for equipment recommendations.
Consult with EMS Advisory Council for guidance in determining Comm Center.	Is the Comm Center managed by an ambulance/rescue service company?	Plan application for equipment, license, financial assistance and installation. Review Section 3.2.1 for equipment recommendations.

2.2 SELECTION OF SPECIFIC FACILITY ROLES IN A REGIONAL PLAN

The overall EMSCS development for achievement of maximum effectiveness requires the participation of all functional EMS facilities which can have a role in providing emergency medical services within a region.

Administrators and Directors of regional facilities other than the Comm Center facility, must become responsible for their specific role in the regional plan. Suggested roles of facilities are provided in this plan and should prove to be adequate guidelines for implementation, however, it is necessary for each region's Health Planning Council and personnel from each participating facility in the region to develop their specific role in relation to other facilities.

Private and public facilities, telephone company operations, ambulance services and local, county and state government agencies have various communication capabilities which are important assets which may be used to provide an effective and economical EMSCS.

The following general terminal and link communication capabilities are required at various facilities. Assessment of these will allow determination of a participating facilities role. Detailed specifications for the required equipments are provided in the Communications Plan, Section 3.0.

FACILITY FUNCTIONS:

Hospital Facility: (1) Provide a two-way telecommunications link from the Emergency Room (ER) to the Comm Center. Terminal equipment in the ER will include a desk set, wall-telephone-set or Telco "spokesman" for two-way communications to the ambulance vehicles. A radio base station may be utilized for:

(a) Communications between the ambulances and the ER.

(b) Paging of emergency personnel (See Section 3.2.8).

(c) In cooperation with Civil Defense plans, a point-to-point radio communications between hospitals, Civil Defense Emergency Operations Centers (EOC) and to the Comm Center for use in a major disaster.

(d) The terminal will require a "phone patch" from the radio base equipment into the telephone links for achieving direct communications links between users.

Ambulance/Rescue Service Operations Center: Provide a telecommunications link to the Comm Center. Terminal equipment required will include a telephone desk set and extension(s) which can be answered twenty four (24) hours per day.

Note: It is not necessary or particularly desirable for there to be radio base stations at ambulance services although monitoring of ambulance to Comm Center and hospital communications is justified. See Section 3.2.8 for paging recommendations.

Law Enforcement/ Public Safety Facilities: Provide a telecommunication link to the Comm Center with a radio "phone patch" to allow direct message transfer from law enforcement vehicles to the Comm Center and from the Comm Center to ambulances when required. Additionally, the mobile units will utilize the statewide public safety Mutual-Aid frequency channel for direct communications to ambulance vehicles.

Note: Authorization by the law enforcement license will be required for ambulance vehicles mobile radios to transmit on the Mutual-Aid frequency (EMS Channel C).

Telephone Company:

(1) Provide for an emergency request message transfer to the regional EMS Comm Center for all ambulance and rescue vehicle requests received via "0" (operator). List dialing information in all telephone

directories and explain how to reach the EMSCS for these emergency requests.

Note: In metropolitan communities the Regional Health Planning Council in cooperation with state and local governmental agencies will want to consider a "911" emergency dialing system to be answered at the regional Comm Center.

(2) Provide lines as required between Comm Centers and hospitals, ambulance/rescue operations centers and to local government agencies.

The relationship of a specific facility to the Comm Center and to other facilities within a region must be known before the selection and ordering of specific equipments and the license application for radio base stations.

Decision Aid Table 2-4 is provided to assist in determining functional relationships prior to facility implementation plan development.

TABLE 2-4 DECISION AID - SPECIFIC FACILITIES ROLES IN THE REGIONAL EMSCS

Action if Answer is "NO"	QUESTION	Action if Answer is "YES"
	Is my facility a Comm Center?	
If my facility is not a Comm Center but is a hospital or ambulance service in the region and desires to participate in the regions EMS program, continue with this decision aid.		See Decision Table 2-3 for Comm Center facility selection details.

TABLE 2-4 (Continued) DECISION AID - SPECIFIC FACILITIES ROLES IN THE REGIONAL EMSCS

Action if Answer is "NO"	QUESTION	Action if Answer is "YES"
Find proper category for my facility further along in this Decision Aid	Is my facility a hospital having emergency care facilities?	If my hospital expects to participate it should provide a common carrier (telephone circuit) to the Comm Center. See Section 3.2.2 for detailed requirements and Section 3.4.7 for specifications.
Establish a plan for installing a direct telephone line service between the Comm Center and the hospital emergency room. See Section 3.2.6 of this report for recommended facility.	Does my hospital emergency department have sufficient activity to warrant a radio for direct communications to ambulance services? See Section 3.2.10 (Message Traffic) for information which defines need for radio usage.	Establish a plan for purchase, installation and licensing of a radio base station. See Section 3.2.2 of this report for detailed requirements and Section 3.4.7 for specifications.
None	Does my hospital have emergency medical personnel and/or ambulance technicians who should be radio paged?	Include in plan for radio base station the ability to provide a paging capability. See Section 3.2.8 for requirements and Section 3.4.7 for specifications.

TABLE 2-4 (Continued) DECISION AID - SPECIFIC FACILITIES ROLES IN THE REGIONAL EMSCS

Action if Answer is "NO"	QUESTION	Action if Answer Is "YES"
Find proper category for my facility in this Table.	Is my facility an ambulance service and/or rescue unit?	If my service plans to participate, develop the plan for equipping ambulances and rescue units to relate properly with the Comm Center frequency channel and the law enforcement Mutual-Aid channel. Provide a line to the Comm Center for request notifications on a 24 hour per day basis. See Section 3.2.3 for detailed requirements and Section 3.4.4 for specifications.
Seek the most effective facility in the region.	Is my facility a local government, public safety or law enforcement agency?	If my facility plans to participate in EMS communications see Section 3.2.5 for requirements and Section 3.4 for specifications of equipment needed for participation.

All citizens who live in Iowa can expect to benefit, in time of emergency, from a fully operational EMSCS. Each public and private facility serving in the provision of emergency actions has a part to play in the cooperative efforts required to make possible a system of this magnitude. Many of the required communication linkages can be enabled from telephone circuits already installed and operational. When emergency communications is required, message accuracy and a minimum response time to requests is required. This can be accomplished through cross linking telephone lines via phone patch with the radio channels by which emergency messages to mobile units are communicated. Many agencies will need little additional equipment other than the phone patch for developing viable linkages with the Comm Centers.

The Communications Plan of Section 3 details the system requirements and specifications for terminal and link equipments which are needed to enable the system to work effectively.

2.3 EMS COMMUNICATIONS SYSTEM (EMSCS) OPERATIONS STATEWIDE

Emergency requests do not respect jurisdictional boundaries, state, county or city lines. Conversely, these boundary lines should in no way impair the service response time, quality of service or area of coverage for the operational EMSCS.

The system plans developed herein recognize regional boundaries based upon county lines. Twenty (20) EMS regions (See Figure 2-2) are designated within the State of Iowa. Regional planning:

1. Utilizes the health planning actions of interested persons in an area small enough for the Regional Health Planning Councils to manage details and coordinate participating facilities.
2. Provides regions large enough for the economical employment of a specialized radio system to allow ambulance-to-hospital communications over an area equal to or greater than required for a normal ambulance run.

The system provides ambulance-to-hospital communications without requiring each hospital to have a radio base station although the system accommodates hospital base stations and will operate more effectively when the hospitals which receive large numbers of emergency patients can communicate with ambulances via their own radio systems.

The effective operation of the EMSCS depends upon the voluntary cooperation of many groups which may serve or be served by it through cooperative action. Hospitals are served through an ability to be informed of patient condition prior to arrival. This information allows advance preparation for a critical case. The ambulance service is improved through a request and dispatch system which allows a shorter response time for starting and completing their run. Law enforcement and public safety

agencies are served through an ability to obtain needed emergency services (ambulance and rescue units) to promptly relieve the trauma victim and restore normal conditions after a highway accident scene or disaster. The citizen on the highway, at home, at work, or in pursuit of recreation can be assured of more responsive rescue or hospitalization should misfortune or accident occur to him or his family.

The EMSCS truly serves a large segment of total health care and trauma relief and can be an adjunct to health and public safety. The EMSCS implementation does not require an entirely new system for it depends upon many system elements already in existance which, by use of this plan, can now be integrated for more efficient and broader scale usage. For example, an EMS Comm Center might not be a new dispatch center but could be achieved by modifications to an existing dispatch facility.

The radio system operated by the Comm Center is largely new and uses frequency channels not used generally today and yet it provides functions ofttimes supplied today through municipal, county and state public safety radio base stations. The communications system planned herein is capable of serving a larger area than the usual county or municipal system and a smaller region than served in the state public safety radio system. The system is statewide in operation and should become an integral part of a statewide radio system serving both highway safety and localized public emergency service agencies.

There are also requirements for inter-state cooperation with adjoining states. It is known that the states of Minnesota, Wisconsin, Illinois, Missouri, and Nebraska are planning EMS communications systems. The statewide frequency channel for ambulance-to-hospitals is the same for most of these states which will allow interstate transfer ambulances to communicate when required.

It is recommended that the responsibility for developing the EMSCS Comm Center implementation, operation and maintenance be vested in the Department of Health, Community Health Services. Agreements may be made with other state, county and municipal agencies for various activities which are a part of this responsibility.

It is recommended that the technical planning responsibility for the EMSCS be that of the Department of General Services, Communications Division. Joint responsibilities must be exercised through action of the EMS Section of the Department of Health, the EMS Advisory Council and the EMS

Communications Task Force to implement the plan. Regional Health Planning Councils, the Iowa Hospital Association and other agencies will have responsibilities in various degrees.

It is recommended that those responsible for the EMSCS engage in interstate EMS communications conferences to develop joint system plans to enable a maximum of commonality of standard procedures and to avoid channel interference of harmful proportions. Digital dialing, tone codes, procedural signals and frequency plans need to be agreed upon. Medical data telemetry standards should be developed and FCC petitions should be presented to assure an economical and implementable system development.

Legislation should be developed and enacted which assures the implementation and continuity of this system and its integration with other statewide telecommunications system elements.

Budgets must be developed and funding obtained through cooperative action of planning agencies responsible for the implementation of Comm Centers, purchasing ambulance radios, and for hospital and law enforcement/public safety agency terminal installations.

3.0 COMMUNICATIONS SYSTEM PLAN

The EMSCS Plan provides for upgrading some existing local systems to meet the EMSCS performance requirements and to allow an orderly integration with new communications system elements as they are installed.

During the construction, installation and operational lifetime of any system, methods are needed to detect and correct system deficiencies before a penalty in performance or cost is realized. Deficiencies in this category may be:

1. Inadequate radio signal propagation reliability.
2. Interference of co-frequency operations.
3. Message traffic overload on a channel.

The following sections develop system parameters and standards for the principal system elements, frequency plans, and message traffic/system response time relations. Specifications are provided for radio links, telephone links and terminals. Lists of equipment and specifications for the various system elements are given, licensing guidelines, operational procedures and recommended procedures for utilizing and evaluating the EMSCS are detailed.

While certain of these will need to be periodically updated as technology changes, general close adherance to the implied standards is recommended for assuring an orderly growth and high performance during the system construction and during initial years of operation.

3.1 GENERAL SYSTEM REQUIREMENTS

Several system functional requirements must be met to assure an adequate capability and performance. These requirements relate to the link operations and equipments needed between a Comm Center and:

1. Ambulance service and rescue unit (operations center)
2. Enroute ambulance and rescue mobile units.

3. Hospital switchboard and hospital emergency room.
4. Law enforcement agency's dispatch control console.
5. Other EMS Comm Centers and Civil Defense Emergency Operations Centers.

System functional requirements must be met for terminal operations and for the equipments needed at the:

1. Comm Center
2. Hospital Emergency Room
3. Ambulance operations center
4. Cooperative law enforcement/public safety agencies
5. Ambulance and rescue mobile units
6. Remote communications base stations in the region

These link requirements and specifications relate to the general system diagram shown on Figure 3-1. Generic configurations are established for each EMS region in Iowa. Each may be readily visualized upon noting the Comm Center stations and hospital location. The functions of the system terminals and links were described briefly in Section 1 and in Section 2.2 and are detailed in the following sections.

3.2 SYSTEM REQUIREMENTS - SPECIFIC TERMINALS

The EMSCS best serves the state, region and community when in each region it can meet the functional requirements.

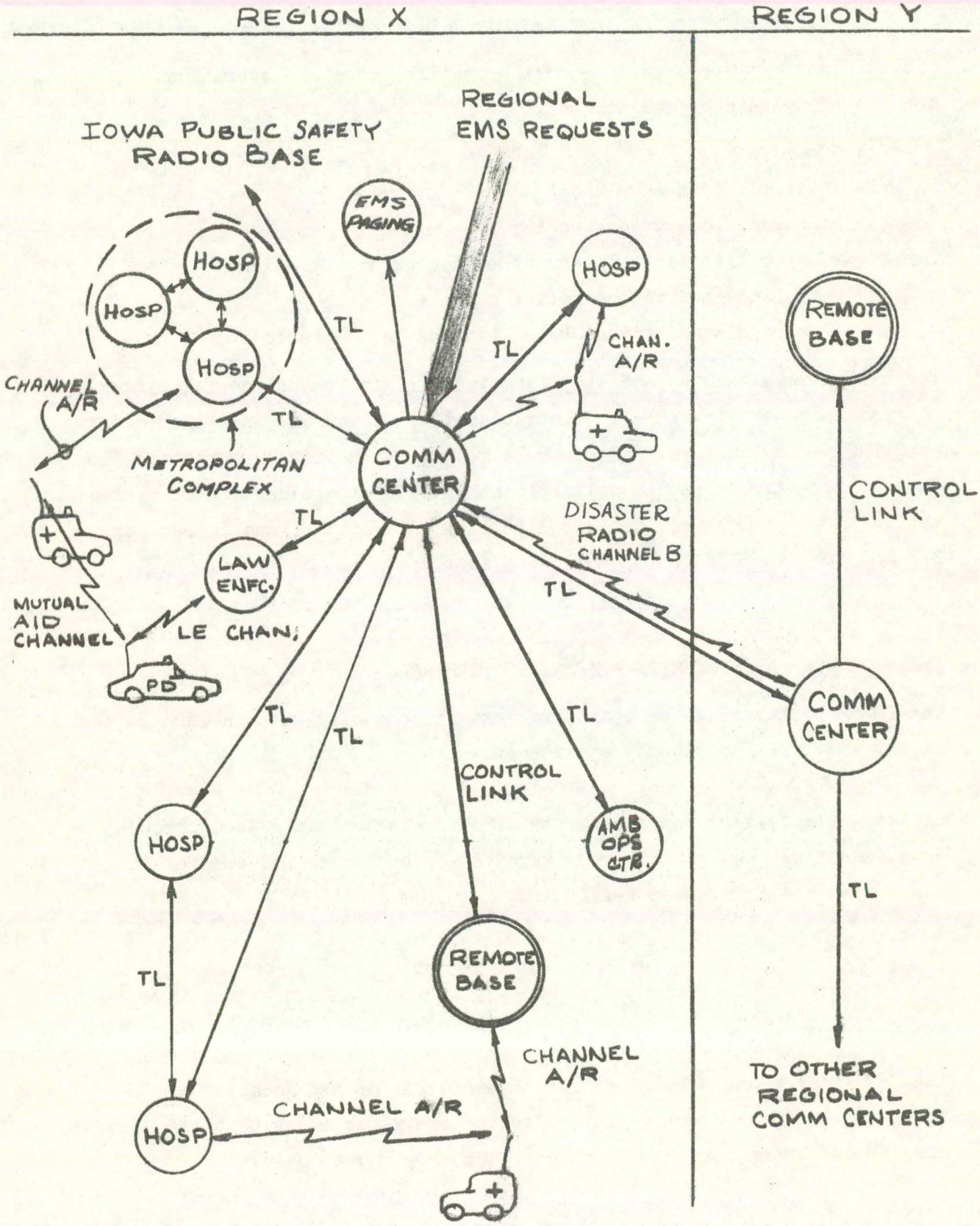
Greater appreciation for the system and its elements is gained through development of the specific requirements for each terminal and for the links into and from these terminals.

3.2.1 COMM CENTERS

The Comm Center has several elements regardless of its location and operational organization. The following paragraphs describe these elements and the different configurations in which they may be used.

FIGURE 3-1

GENERIC EMS COMMUNICATIONS SYSTEM DIAGRAM



TL = TELECOMMUNICATION LINK

COMM CENTER ELEMENTS

The fundamental Comm Center elements are:

1. The telephone Call Director
2. The call recorders
3. The "phone patch"s
4. The communications control console(s)
5. The radio base station transmitters, receivers, tower, antenna, and transmission line and control console.
6. The emergency power
7. The control link to any remote base station(s)
8. The remote base station(s)

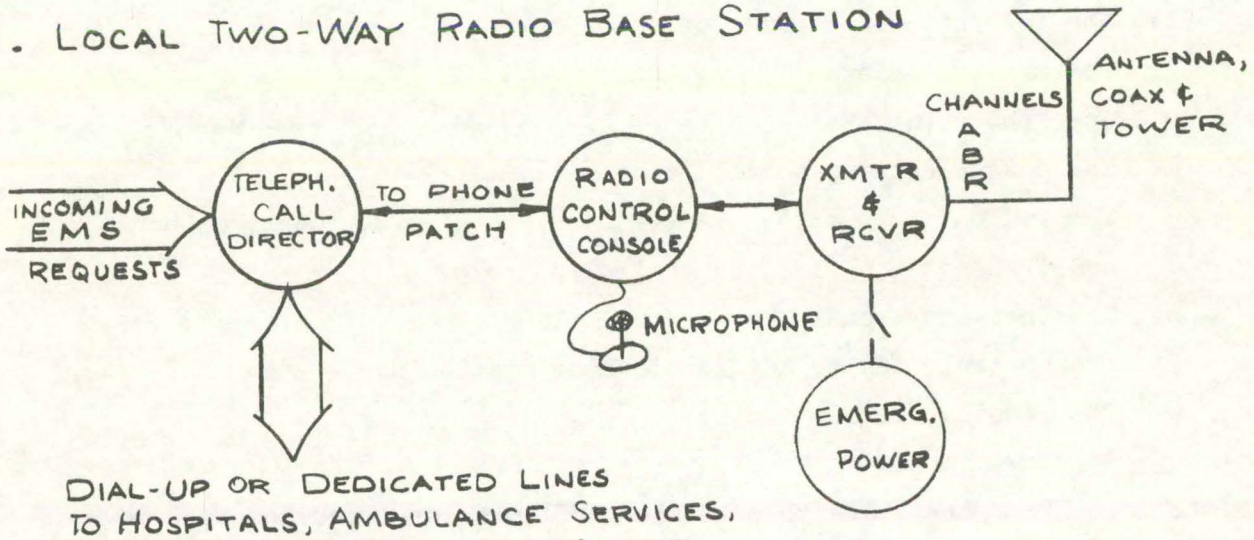
In the Iowa EMSCS there are three basic configurations required in Comm Center radio base station operations. These are shown in Figure 3-2 for:

1. A local radio base station:
   Where the radio communications reliability for the region is adequate when the base station is located within a few hundred feet of the Comm Center.
2. A remote radio base station:
   Where the Comm Center location is not centrally located to pro-provide reliable radio communications to all parts of the region, a remote location for the base station is necessary. In this configuration a remote radio base station site is selected at distances up to several miles from the Comm Center and is remotely controlled via a common carrier link.
   Note: Telco control is recommended for initial implementation although the control link may be a microwave link when several separate channels are controlled and monitored.
3. A local plus remote radio base station(s) - Multi-station remote bases:
   Where the Comm Center location requires a local base station and one or two remote bases for the primary regional signal coverage and for communicating into remote counties. (There are two regions, 5 and 16, requiring a two-remote-base configuration. These bases are controlled from the Comm Center via two sets of

FIGURE 3-2

TELECOMMUNICATION SYSTEM DIAGRAM
GENERIC COMM CENTER

I. LOCAL TWO-WAY RADIO BASE STATION



II. REMOTE TWO-WAY RADIO BASE STATION

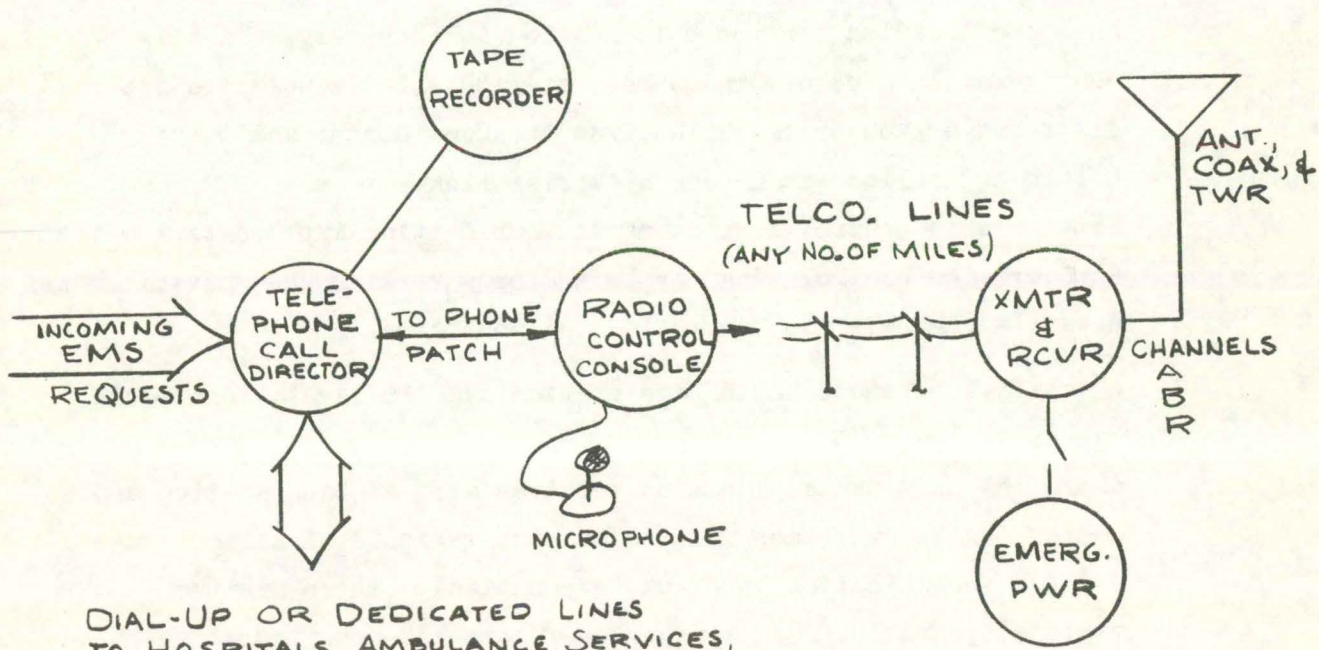
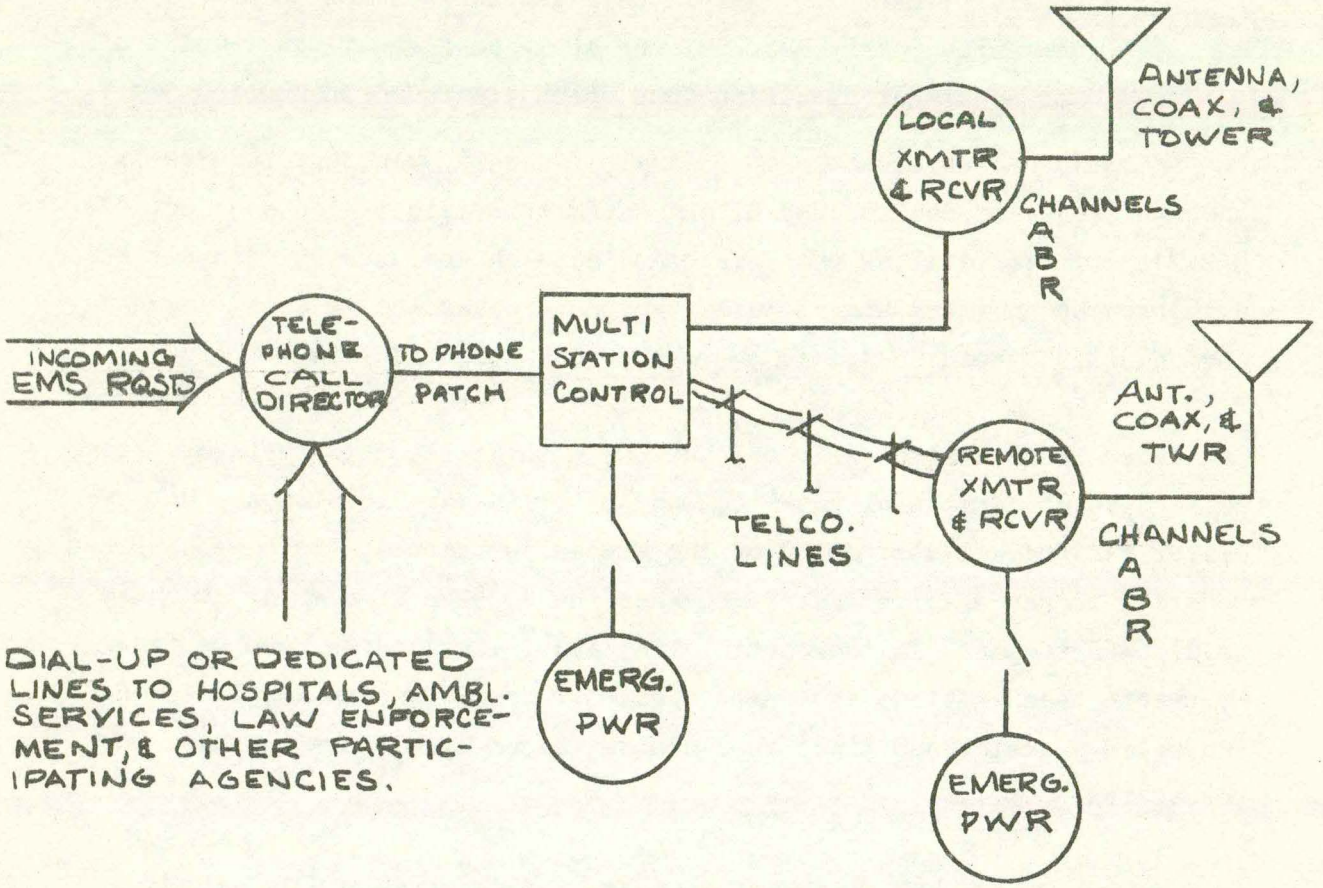


FIGURE 3-2 (CONT.)

III. LOCAL PLUS REMOTE TWO-WAY RADIO BASE STATION.



IV. MULTI-STATION REMOTE CONTROL TWO-WAY RADIO BASE STATION.

SAME AS III EXCEPT, EXTERNAL TELCO. LINES USED BETWEEN CONTROL CONSOLE AND <u>BOTH</u> REMOTE RADIO STATIONS.

control lines. The remote base station(s) must be provided with emergency power. Each of the above configurations require similar equipment specifications which are found in Section 3.4.1.

The FM radio system operates in a single frequency simplex, push-to-talk mode on frequency channels A, B, and R (for specific region see Section 3.2.7). Digital dialing and tone coded squelch are used on channels A and R to provide an alert signal to a desired receiver and to avoid unwanted communications being heard in emergency rooms (See Section 3.2.11).

Each base radio station will be equipped with at least two separate receivers, each capable of two-frequency priority scan reception. One receiver will have its priority on the statewide channel. Both receivers scan all channels for signals, and when the squelch is opened the audio is allowed to pass via the control link audio line to the Comm Center. At remote base stations the outputs of both receivers can be placed on two pairs of telephone lines to conserve leased line operating cost for the system.

At the Comm Center the two-receiver audio outputs can be split into two speakers, one on the left and one on the right, to allow the operator to differentiate. Further differentiation of the received channel is brought about by using a tone actuated indicator light on the console for one of the channels which allows an absence of the indicator light to indicate the other channel. Thus, two speakers and two control indicator lights will allow the operator to know which channel has the incoming signal so he can select a corresponding transmit frequency.

Incoming EMS request calls are received and recorded by the dispatcher through the Telco Call Director. Dispatch action and information to ambulances and hospitals is transferred to appropriate lines via the Card Dialer and Call Director. Radio transmissions to ambulances and rescue units are handled in the normal two-way radio operations by the dispatcher. Direct communications between the hospital emergency room personnel and ambulance mobile units can be phone patched via the dial-up or dedicated telephone line between

the hospital and the Comm Center. The radio base station is connected via a phone patch into the telephone line to the hospital. The dispatcher monitors the patched link.

RADIO SYSTEM DESIGN PARAMETERS

The Comm Center radio base station and remote base system parameters are shown in the following paragraphs.

The parameters have been selected to provide acceptable quality base/mobile radio communications and to produce a minimum of interference from region to region. The signal reliability predictions are based upon the Spectra Radio Communication Prediction Program (SRCPP)(Reference 3). This program was utilized to estimate the nominal antenna heights and power levels required for the expected statistical characteristics of the region. This program has proved its capability to accurately characterize base-to-mobile radio communications performance and recognizes the statistical variations of the physical characteristics of the radio signals, the terrain, the transmitting and receiving equipment parameters, and external noise.

It is recommended that upon selection of an available site for base stations and prior to procurement of site and equipment, the SRCPP or equivalent should be utilized for analysis of the communications from a specific site. Site acreage, tower heights and attendant site development costs can be greatly reduced through this technique.

The Comm Center radio parameters are:

1. Service Probability Index - 50% minimum level (The confidence level at which word intelligibility of over 95% will be obtained for the specified time availability and location variability).
2. Required Signal to Noise - 50 dB (1 Hz predetection bandwidth)
3. Time Availability - 0.95 (a protection factor which assures the required signal-to-noise

is obtained 95% of the time)

4. Location Variability - 0.70 (Possible mobile locations are assumed to be better than the worst 30%).

5. External Noise Grade (Mobile and Base) - Suburban (Grade 3) which assumes a moderately quiet radio noise location remote from high voltage power lines and busy thoroughfares.

6. Receiver Sensitivity - Less than 0.4 microvolt for 20 dB quieting in 16 F3 modulation. (Assumes that an antenna coupler is used when there are multiple receivers per antenna).

7. Terrain Roughness - A value representing the terrain roughness in each region.

8. Antenna Gain - Base station: 8 dbi, omni or as listed Table 3.2-1
Mobile: 1 dbi

9. Antenna Height - Base: Radiation center as listed in Table 3-1.
Mobile: 6 feet (Roof top mount)

10. Transmission line - 7/8 inch diameter when length exceeds 150 feet (foam dielectric)
1/2 inch diameter Heliax when length is under 150 feet (foam dielectric)

11. Transmitter output power - Base station and mobile: 100 watts

These parameters were used to determine:

- The approximate reliable coverage radius,
- The antenna heights,
- The antenna gain/directionality,

and most importantly:

- The radio base and remote base station(s) location in each region.

This information is listed in Table 3-1.

Note: Similar parameters were used for the estimation of hospital radio

TABLE 3-1 REGIONAL COMM CENTER AND REMOTE BASE SIGNAL COVERAGE AND ANTENNA PARAMETERS

	COMM CENTER			REMOTE BASE		
Reg No.	Location	Antenna height and type(equip)	50% S.P. Radius of Coverage Amb/Page	Location	Antenna height and type	50% S.P. Radius of Coverage Amb/Page
1	Decorah	160 feet (DB-214-2)E-W	36/26	Elkader DB-225-2(SE)	180 feet	31/21
2	Mason City	260 feet DB-224 Omni	50/29	Woden	80 feet DB-225-2(W)	31/21
3	Spencer			North of Ruthven	80 feet DB-224,Omni	31/21
4	Sheldon			Boyden	260 feet DB-224,Omni	40/29
5	Sioux City	80 feet DB-224,Omni	31/21	Onawa East of Washta	40 feet DB-224,Omni 80 feet DB-214-2(NW-SE)	28/15
6	Storm Lake			Varina	80 feet DB-224,Omni	31/21
7	Fort Dodge			Vincent	80 feet DB-224,Omni	31/21
8	Cedar Falls/ Waterloo			Denver	320 feet DB-224,Omni	42/34
9	Dubuque			Asbury	260 feet DB-224E (NW-SE)	40/29
10	Davenport	260 feet DB-224,Omni	40/29			

TABLE 3-1 (Cont.) REGIONAL COMM CENTER AND REMOTE BASE SIGNAL COVERAGE AND ANTENNA PARAMETERS

COMM CENTER				REMOTE BASE		
Reg. No.	Location	Antenna height and type(equip)	50% S.P. Radius of Coverage Amb/Page	Location	Antenna height and type	50% S.P. Radius of Coverage Amb/Page
11	Cedar Rapids	260 feet DB-224E(E-W)	40/29			
	Iowa City (Special)	160 feet DB-224,Omni	36/26			
12	Marshalltown	320 feet DB-214-2(NW-SE)	42/34			
13	Des Moines			Bondurant	320 feet DB-224,Omni	42/34
14	Atlantic			Adair	160 feet DB-224,Omni	36/26
15	Carroll	260 feet DB-214-2(E-W)	40/29			
16	Council Bluffs	240 feet DB-224,Omni	40/29	Portsmouth	160 feet DB-214-2(E-W)	28/15
				Imogene	80 feet DB-224,Omni	31/21
17	Creston			Shannon City	160 feet DB-214-2(E-W)	36/26
18	Chariton	320 feet 100W DB-225 SE	42/34			
19	Ottumwa	320 feet 100W DB-225 (SE)	42/34			
20	Burlington (911)			West Burlington	160 feet DB-224E(NE-SW)	36/26

facility base station signal propagation. These are discussed in Section 3.2.2.

3.2.2 FACILITY DESIGN PARAMETERS

HOSPITAL-NON-COMM CENTER (NO RADIO BASE)

The terminal for a single hospital in a region is relatively simple as shown in Figure 3-3. Terminal equipment can be added to the existing telephone system to provide a dial or dedicated direct linkage between the Comm Center and the hospital emergency room. In the case where the hospital operates an ambulance service, a direct linkage to the ambulance operations center is also required. In the Emergency Room and Ambulance Operations Center a wall desk set unit or Telco "Spokesman" is utilized to monitor and respond to communications.

Telephone lines are recommended for communications to other regional hospitals unless the hospital has become a part of the Civil Defense EOC emergency system which will allow usage of a radio point-to-point channel. A tape cassette recorder usage is recommended in the Ambulance Operations Center for purposes of assuring that dispatch information for ambulance personnel was properly received and transferred.

HOSPITAL TERMINAL WITH RADIO BASE

A hospital terminal within a region having a relatively large message load should utilize the foregoing telephone linkages to Comm Centers and other hospitals and additionally employ a two-way radio base station to communicate directly with ambulances carrying emergency patients to it. Refer to Section 3.2.10 to establish the message traffic load at which this action would be appropriate. The radio base station will be operated from the emergency room via a remote desk set with a monitor in the ambulance operations center when there is an ambulance service. The receiver complement is just as used in the Comm Center base station.

Each hospital radio system will be assigned a digital dialing code and a TCS tone. (See Section 3.2.11)

The radio base station may be used for emergency personnel paging as discussed in Section 3.2.8. Hospital radio base stations, for communications with ambulances, should operate to a communications radius of approximately twenty (20) miles. Paging of emergency personnel, when using SERS frequencies, should be restricted to ten (10) miles or less. Paging transmitter power levels are ofttimes increased to compensate for the lower sensitivity page receivers. This should be avoided on SERS frequencies.

Generally the antenna height above average terrain should be approximately forty (40) feet. The transmitter power output should be fifty (50) watts or less. The antenna should have 6 dBi gain and an omnidirectional pattern. When the installation of the system is being planned, the specific siting related to terrain and tower height must be completed by communications engineers skilled in this work to meet the criterion of 50% service probability at twenty (20) miles with restriction of signal coverage beyond a twenty (20) mile radius. This design will prevent inordinate signal interference with the Comm Center operation and between hospitals in most regions.

HOSPITAL TERMINAL - METROPOLITAN RADIO

Metropolitan regions having two or more closely located hospitals require additional considerations if the Comm Center message traffic warrants a radio system (Section 3.2.10) in the hospital.

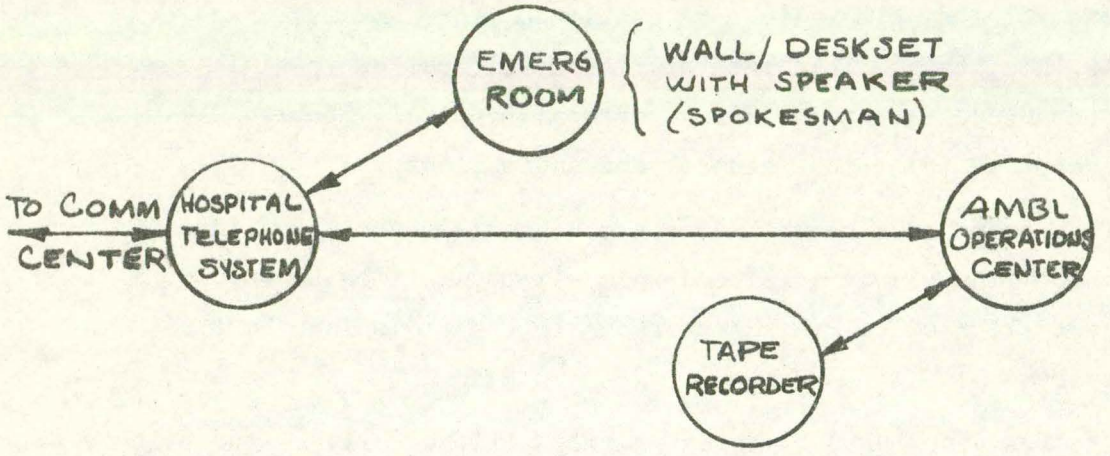
For each hospital to acquire a radio system:

1. Would produce an interference potential which can easily reduce the effective channel capacity below that required in the area,
2. Would be inordinately expensive,
3. Could reduce the expected benefits of the entire regional EMSCS operations.

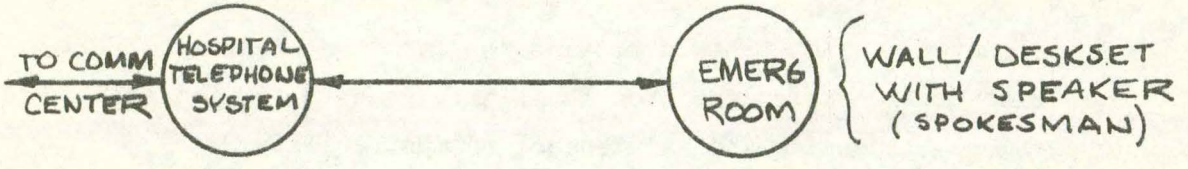
The problem can be resolved as recommended in the following design

FIGURE 3-3
TELE COMMUNICATIONS SYSTEM DIAGRAM
HOSPITAL — NON-COMM CENTER

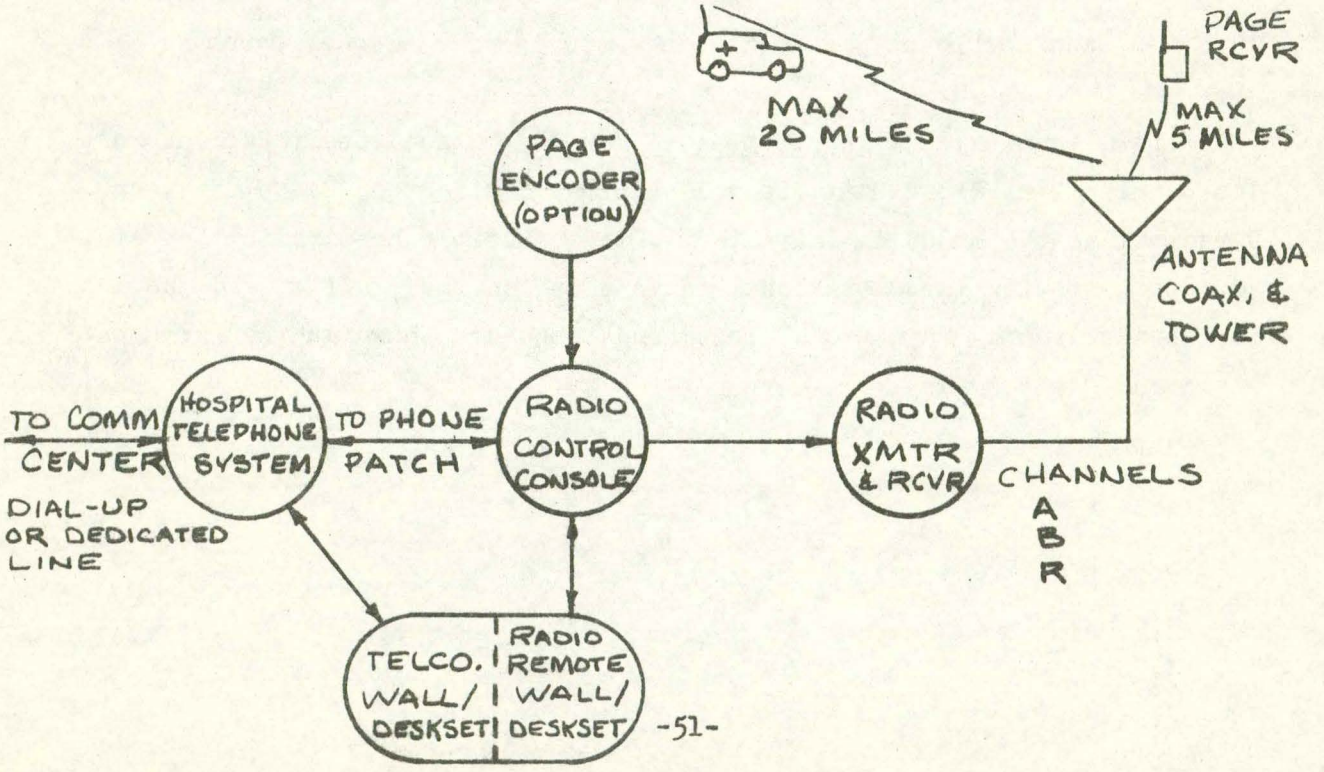
I. AMBULANCE BASED AT HOSPITAL WITHOUT RADIO.



II AMBULANCE NOT BASED AT HOSPITAL WITHOUT RADIO.



III. HOSPITAL WITH RADIO



arrangement:

1. Install a single radio base station having a shared usage by the hospitals. This base station specification is similar to the recommended equipment for a regional hospital, Section 3.4.6, except in the remote control and audio linkages.

   The remote desk or wall sets are connected onto a dedicated telephone line via parallel controls via phone patch to interconnect all hospital emergency rooms to the radio input/output system.

2. The frequency used by this facility will normally be the primary (R) channel, to reduce potential interference with Comm Center traffic. The operational benefit is to allow two-channel operation in the region and thus achieve an increased message traffic capacity.

3. A designated hospital should provide the location of control for the base station dependent upon local arrangements for financing, operations, licensing and maintenance of the facility.

4. The terminal equipment and control could be located at the Comm Center, however, the radio base station must be separated from the Comm Center base a mile or more to avoid receiver overload when there is simultaneous transmission required on an adjacent channel. Each should be provided with a source of emergency power.

This operational system <u>is recommended</u> for Des Moines, Cedar Rapids, Waterloo/Cedar Falls, Sioux City, Council Bluffs, Burlington, Mason City, and Davenport as the EMSCS is initiated. Other multiple hospital cities are advised to review the operational advantages and the traffic load justification criteria. Additional recommendations are shown in the Implementation and Cost Summary.

3.2.3 AMBULANCE OPERATIONS CENTERS

The ambulance operations center are served by dial up or dedicated telephone lines to the Comm Center and associated terminal equipment. Line numbers vary dependent on traffic but must be sufficient to carry the requests with a maximum answer time of fifteen (15) seconds. A rotary number arrangement and a sufficient number of desk sets or extensions are required to serve the needs. Administrative telephone number(s) should be separated from the emergency rotary to avoid blocking the emergency lines. (Section 3.4.2). It is recommended that an on-line recorder be employed to assure that dispatch information is received correctly. Figure 3-4 shows the connection diagram. Optionally, a scanning type monitor radio receiver for the A, R, and P channels may be utilized.

3.2.4 AMBULANCE VEHICLE

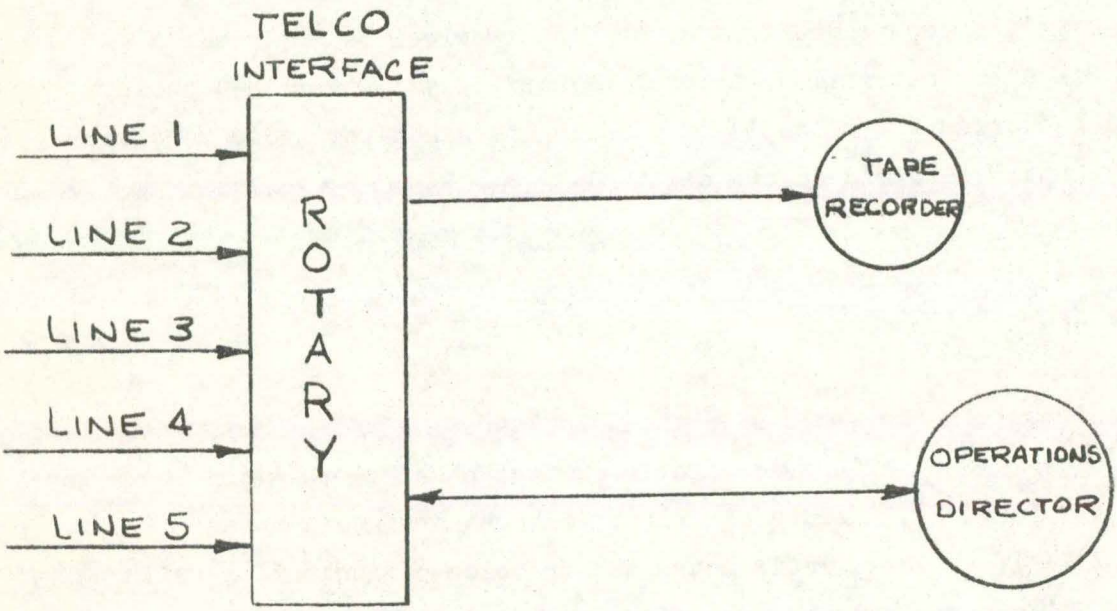
The radio equipment in the vehicle is shown in Figure 3-5. The transceiver for voice communications is capable of four-channel operation on channels A,R (region), C and a spare (for channel designation, see Section 3.2.7). Its primary radio usage is for voice communications with Comm Centers while enroute to an emergency or when transferring patients long distances. After the patient is settled in the ambulance and the receiving hospital determined, the Comm Center dispatcher will establish a direct link between the receiving medical facility and the ambulance via a patch through the Comm Center or direct the ambulance to use the hospital base station channel.

An extended control unit is supplied so that voice communications may be enabled from either the ambulance driver or the attending medical technican(s).

Provision can be made to utilize a portable transceiver to communicate with the ambulance should it become necessary to perform medical assistance away from the ambulance. Utilization of channels A or R is recommended. Refer to Section 3.2.9 for a description of the required system elements,

FIGURE 3-4

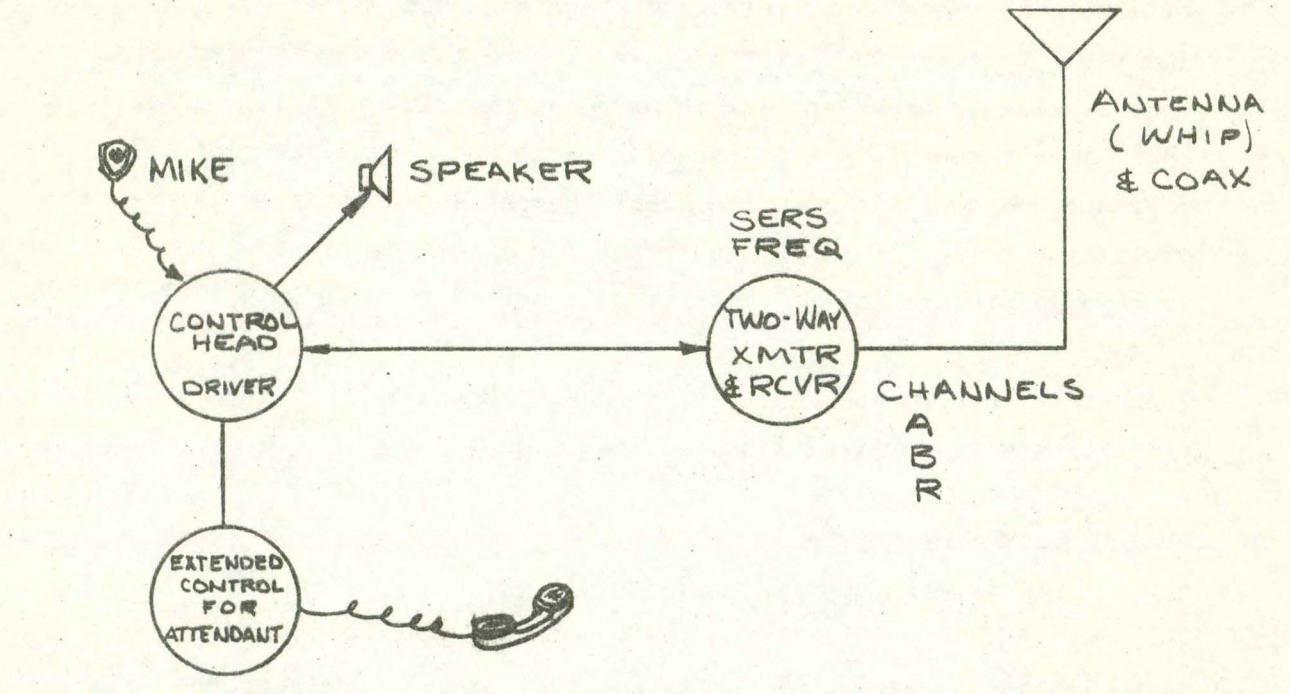
AMBULANCE OPERATIONS CENTER — NON-COMM CENTER



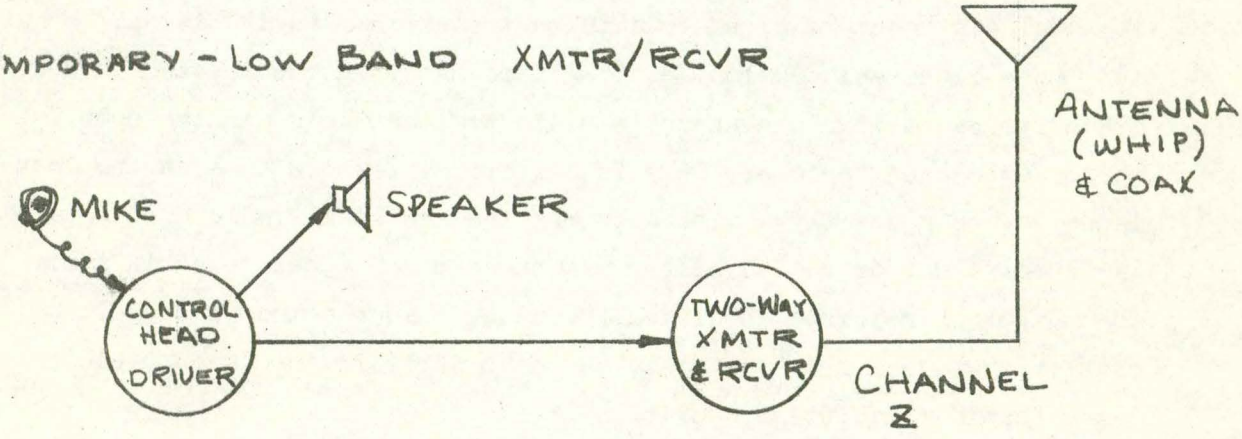
NOTE: TELCO LINE REQUIREMENTS ADJUSTED TO NEEDS.

FIGURE 3-5

AMBULANCE COMMUNICATION EQUIPMENT



TEMPORARY - LOW BAND XMTR/RCVR



possibilities and problems in utilizing medical data telemetry.

While the recommended EMSCS utilizes the VHF SERS high-band channels, Channel Z (37.10 MHz) equipment is presently utilized for law enforcement and local government communications and local EMS communications. This equipment may continue to be utilized so long as cross licensing of ambulance radio is approved and the system has viability. It is not desirable to expand use of this channel for it has much interference from local government and law enforcement priority traffic. In regions where ambulances carry the Channel Z equipment a temporary installation of remote control lines to the local Channel Z base station is advised during the period of EMSCS equipment installation. It is more important to have an operational EMS link than to wait for a complete installation.

Phone patch equipment may be utilized with Channel Z equipment output to cross link with terminal lines.

3.2.5 LAW ENFORCEMENT AND LOCAL GOVERNMENT

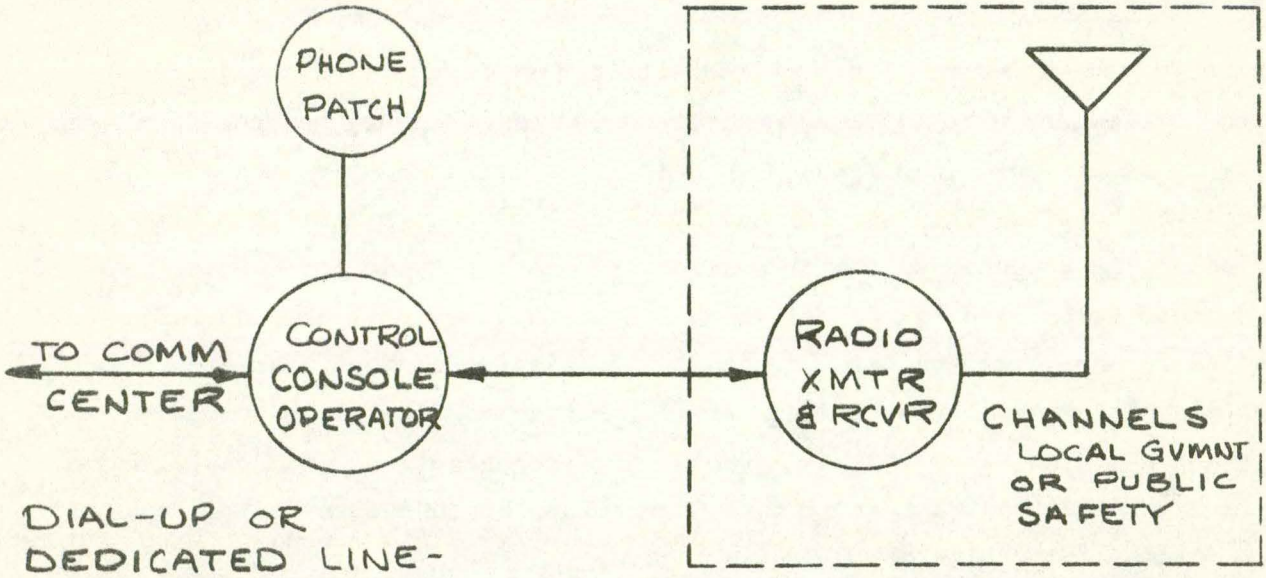
Communications linkages are necessary and important between the Comm Center and law enforcement/local government agencies (public safety). Figure 3-6 shows the diagram of these linkages.

Terminal equipment required to acquire these linkages is minimal because telephone lines and terminal equipment is used. A phone patch is recommended to cross-link the agency's radio base channels via the Comm Center to the ambulance vehicle. This is a required feature because the ambulance is not generally equipped to receive the local radio channel of the law enforcement or public safety. A phone patch makes possible limiting the number of required ambulance frequency channels and the resulting complexity. Good practice minimizes complexity in ambulance vehicle communications equipment operation.

The State tactical (mutual-aid) frequency of 155.475 MHz (Channel C) is specified in this plan for ambulance vehicle use in making emergency

FIGURE 3-6

LAW ENFORCEMENT AGENCY - NON-COMM CENTER



DIAL-UP OR DEDICATED LINE- DEPENDING ON TRAFFIC LOAD

NOTE: CAPABILITY & FACILITY MAY BE CURRENTLY AVAILABLE IN SOME AREAS OF THE STATE

contacts with law enforcement vehicles. This is a new development having many direct benefits to emergency communications. It is recommended that the Iowa Department of Public Safety develop a procedure for controlling the usage of this channel, which permits ambulance and rescue vehicles to be licensed for its use only for emergency communications with public safety and law enforcement mobile units.

3.2.6 TELEPHONE SYSTEM

EMS REQUEST ENTRY

There is presently no uniform method within most communities and in rural areas of Iowa by which accidents are reported or emergency medical service is requested. This results in delay in obtaining assistance and sometimes multiple requests for service. In order to correct this situation, it is recommended that provision be made statewide for EMS requests to be handled by the telephone system on a region-by-region basis in the manner described below. Details relating to a specific regional implementation should be handled first by contacting the State Communications Division, (515) 281-3336 who may refer contacts to Mr. Jess C. Lang, Data Communications Manager - State Government, Northwestern Bell Telco, Des Moines, Iowa 515-281-6974.

In the larger metropolitan areas of the state, a single seven digit telephone number for the regional EMS Comm Center will be listed under AMBULANCE inside the front cover of the local telephone directory. In addition, all requests for an ambulance which are made directly to a local telephone operator by dialing "0" will be transferred directly to the Comm Center serving the metropolitan EMS region.

Smaller communities and rural areas are often served by a mixture of independent telephone companies and Northwestern Bell Telco. Each of these companies have either separate community directories or a single directory serving several communities. Furthermore, the telephone companies transmission network and switching arrangements are not constructed with con-

sideration for governmental divisional boundaries. This makes it very difficult to list a single seven-digit number inside the directory front cover for a wide area request. It is possible, however, to list under AMBULANCE the single number "O", for Operator. Whenever a person dials "O", the answering operator, irrespective of geographical location, knows the community originating that call. As soon as the operator has determined that the caller wants an ambulance, the call can be routed to the regional Comm Center serving the originating area. The cost of this telephone call will be charged to the Comm Center and has been estimated to average one dollar ($1.00) per EMS request.

It is recommended that each Comm Center have at least two incoming emergency telephone lines on a rotary sequence in order to handle a second incoming EMS request, if the first line were busy. In larger areas more than two rotary lines may be necessary to meet a criterion that emergency service request calls should be answered in fifteen (15) seconds.

911 EMERGENCY REPORTING

The 911 emergency reporting system was announced in 1968 by the Bell System (Reference 9). By dialing 9-1-1 all emergency calls within a defined area are connected directly to a central emergency switchboard. Two Iowa communities, Burlington, and Clinton, in cooperation with Northwestern Bell Telco have 911 systems in operation. These emergency Comm Centers handle all incoming 911 calls involving police, fire and ambulance/rescue units in those communities. Metropolitan areas and possibly the entire state will eventually have 911 systems operating. The ability to use a 911 system for an entire EMS region will depend on a number of factors, including but not limited to the desires of governmental units involved, cooperation of the several telephone companies providing service to the region, and the regions willingness to pay for the service.

The primary contact on 911 systems at Northwestern Bell Telco is given in the first paragraph of this section.

RECORDING OF EMS REQUESTS

At each Comm Center, the incoming EMS request lines will be provided with terminations for a beeper and tape recorder. The beeper is required to comply with FCC Rules and Regulations for recording of interstate telephone conversations and for intrastate recording determined by Iowa State Tariff Regulations.

It is recommended that a petition be prepared by cognizant state officials for elimination of the beeper requirement for emergency services communications recording. The tape recorder will record all conversations on the incoming EMS request lines. This allows the Comm Center operator to "play back" the tape in the event he or others have a question as to the location provided and directions given for the requested emergency medical service and can provide legal authenticity should it be necessary to introduce the recording as evidence in a Court of Law.

The Comm Center telephone instrument or Call Director (See Section 3.4.2) will be equipped with a "Post-record" button which will allow the Comm Center dispatcher to record his own pertinent comments immediately following a request record. These data can include but not be limited to such items as date, and time the request was received, serial number of request data sheet, which ambulance/rescue unit was dispatched, the ambulance departure time, etc.

Cassette recorders available have no provision to indicate that the "end-of-tape" is approaching. Therefore, it is recommended that the Comm Center Operational Procedures Manual contain the requirement that the quantity of unused tape in the cassette is to be checked and recorded in the log at the beginning of each shift and at the end of the emergency request or post-record section. When ten (10) percent or less record time remains the cassette should be turned over or replaced if that is the end of the second side. Whenever a cassette is turned over or permanently removed from the recorder, the "no-record" tab on the top edge of the cassette should be broken out. This prevents accidental re-use of that cassette thus destroying the message contained thereon.

The recorder cassettes should be filed in a special storage cabinet in which the tapes will not be effected by magnetic fields which can destroy the recorded messages. The cassettes should be stored until such time as there is little possibility that they will become a part of any litigation. It is recommended that the length of time required for EMS record retention be included in any pending EMS related legislation.

COMMON CARRIER SERVICES

The need for statewide communications between Comm Centers and into the special Comm Center at University Hospitals makes highly desirable the following recommendation. It is recommended that GSA Telpak and/or a common carrier facility be considered in future expansion plans for linking the Comm Centers and providing communications links from Comm Centers to hospitals and ambulance service operators.

3.2.7 SERS FREQUENCY UTILIZATION

The radio frequencies which are available for use in the EMSCS are the Special Emergency Radio Service (SERS) frequencies listed in Volume V, Part 89, Public Safety Radio Service, Section 89. 525 (f) of the FCC Rules and Regulations. See Appendix A of this report.

As outlined in the sections below, all EMS voice communications in Iowa will use the high-band SERS frequencies.

CHANNEL DESIGNATIONS

In order to establish a convenient reference to the SERS frequencies used in Iowa EMSCS, the following designators will be used:

Channel	Frequency MHz	Purpose
A	155.340	Hospital-to-ambulance, Comm Center-to-Ambulance, Ambulance-to-Ambulance (Statewide)
B	155.235	Comm Center-to-Comm Center, Civil Defense (EMS), Hospital to Comm Center (Statewide point-to-point)
C	155.475	State Public Safety Mutual Aid
D	154.280	Mutual Aid, Fire (Non-SERS)
R1	155.325	Regions 3, 9, 13, 16, 20
R2	155.355	Regions 1, 6, 10, 14, 12
R3	155.385	Regions 2, 4, 11, 15, 18
R4	155.400	Regions 5, 7, 8, 17, 19
P	155.295	Statewide EMS Paging
Z	37.10	Statewide local government/ law enforcement

Other specific channel designators may be established by APCO as the need arises. Two-way radio communications for EMS in Iowa will not make use of the low-band SERS frequencies under this plan. However, some of them (See Appendix A) can be used for one-way paging activities as is discussed in Section 3.2.8.

The EMSCS described in this report is open ended with respect to the use of the UHF SERS frequencies. A further discussion of the use of these frequencies appears in Section 3.2.9 on Medical Data Telemetry.

SERS FREQUENCY COORDINATION

In order to promote the orderly assignment of SERS frequencies, it is recommended that Iowa SERS frequency coordination be established under the cognizance of the Associated Public-Safety Communications Officers (APCO). "This frequency advisory committee must be so organized that it is representative of all persons who are eligible for radio facilities in the service concerned in the area the committee purports to serve." *

* FCC Rules and Regulations, Part V, Section 89.15(b) (2).

This means that the APCO committee must include persons representing the state organizations and professional societies for

- hospitals,
- ambulance/rescue unit operators,
- physicians and veterinarians,
- disaster relief organizations,
- school bus operators,
- beach patrols,
- isolated area establishments,
- communication standby facilities,
- emergency public communication facilities.

The interests of several of these functions could be represented by the State Director of Communications or his designee.

The current assignments of SERS frequencies in Iowa are shown in Table 3-2. This table is presented to provide a data base for future APCO SERS frequency coordination activities and provides in this report a basis for EMSCS frequency selection recommendations.

SERS FREQUENCIES BETWEEN 155.160 and 155.295 MHz

The eight (8) lowest 155 MHz SERS frequencies may be assigned for use by any person, agency, organization, company, etc. who qualified under Part 89, Subpart P of the FCC Rules and Regulations and who are listed in the first paragraph of the SERS Frequency Coordination section. The number of licenses issued to those qualified in Iowa and within a seventy five (75) mile band adjacent to the Iowa borders on the frequencies, 155.160 MHz through 155.295 MHz, are shown in Table 3-2. These frequency assignments do not appear to form a pattern other than possibly geographical, because there has been no previous Iowa SERS frequency coordination activity. The assignment of any of this group of eight (8) SERS frequencies is important to the EMSCS because improper systematic assignments could result in equipment complications and uncontrollable interference.

TABLE 3-2 APPROXIMATE NUMBER OF FCC LICENSES ISSUED IN AN AREA ENCOMPASSING IOWA PLUS 75 MILES INTO THE ADJACENT STATES

SERS(VHF) High-Band Frequency MHz	EMS Radio Channel Designation	FCC Licenses Issued in Iowa					FCC Licenses Issued Within 75 miles of Iowa Border						
		Physicians	Veterinarians	Schools	Hospitals	Ambulance	Nebraska	Minnesota	Illinois	Wisconsin	Missouri	So. Dakota	Total (Iowa + 75 miles)
155.160		1	12	1	0	1	6	2	2	1	0	2	28
155.175		1	1	0	0	0	1	0	0	0	1	0	4
155.205		0	5	0	0	0	0	1	0	0	0	1	7
155.220		0	7	2	0	0	2	6	2	0	3	1	23
155.235	B	0	0	0	0	0	1	0	0	0	0	1	2
155.265		0	2	0	0	0	0	1	1	0	0	1	5
155.280		0	9	1	3	1	3	5	4	0	0	1	27
155.295	P	0	0	1	0	0	0	1	3	0	0	0	5
155.325	R1	0	0	0	1	0	1	0	5	0	0	0	7
155.340	A	0	0	0	9	0	2	5	6	0	2	0	22
155.355	R2	0	0	0	0	0	0	0	0	0	0	0	0
155.385	R3	0	0	0	0	0	0	0	0	0	0	0	0
155.400	R4	0	0	0	1	0	1	0	1	0	0	0	3

Since there are no FCC licenses issued in Iowa and only two licenses issued within the seventy five (75) mile band surrounding Iowa:

1. It is recommended that 155.235 MHz be used statewide for hospital-to-hospital, Comm Center-to-Comm Center and Comm Center-to-hospital point-to-point emergency communications. Antenna height and radiated signal power for these point-to-point communications should be consistent with distance, location and terrain considerations.
2. It is recommended that the use of 155.235 MHz point-to-point radio channel be implemented only when its function has been included in a Civil Defense area plan for regional disaster operations. This will conserve radio spectrum and make possible a relatively clear channel when natural and man-made disasters threaten or strike and when common carrier facilities are disabled. At other times, common carrier and telephone facilities should be utilized for point-to-point communications channels.

Providing there is no favorable resolution of the FCC Docket 19643 to allow EMS personnel paging on the 157.450 MHz channel, it is recommended that the SERS 155.295 MHz (Channel P) be utilized for statewide paging of medical and ambulance technician personnel by hospital and ambulance operations. See Section 3.2.8.

SERS FREQUENCIES BETWEEN 155.325 AND 155.400 MHz

The five (5) SERS frequencies 155.325 MHz through 155.400 MHz are "available for assignment only to hospitals eligible under Section 89.503 and to those ambulances which submit a showing that they render coordination and cooperation with a hospital authorized on this frequency". * FCC Rules and Regulations Part V, Section 89.503 reads:

* FCC Rules and Regulations, Part 5, Section 89.525 (f) (17).

"89.503 Hospitals

(a) Eligibility

"Institution or establishments offering services, facilities, and beds for use beyond twenty four (24) hours in rendering medical treatment".

All the current assignments of these frequencies shown in Table 3-1 concurs with this regulation.

1. It is recommended that the 155.340 MHz frequency be used for statewide communications between ambulances and Comm Centers, ambulances and hospitals, and between ambulances. This provides radio communications between any ambulance traveling in Iowa and a Comm Center. Emergency personnel paging on this frequency is permitted by a Comm Center but must be limited to EMTA's, other ambulance personnel and cardiac arrest teams. (See Section 3.2.8)

2. It is recommended that the regional frequencies of 155.325, 155.355, 155.385, and 155.400 MHz be used as an additional channel within an established EMS region when traffic loading or special operations justify their assignment.

SERS FREQUENCIES - REGIONAL PLAN

Figure 3-7 shows a recommended EMS regional frequency assignment plan using the four SERS hospital/ambulance frequencies discussed in previous paragraphs. This plan is developed to minimize interference between co-frequency regions. By using the same antennas and base station locations as used for 155.340 MHz, coverage of the region will be provided. These regional frequencies will be used to prevent interference on the statewide frequency in those regions which are expected to have heavy message traffic loading. Interference is mitigated in two ways:

1. Through use of an additional channel.
2. Through the ability to use tone squelch on the A and R channels combined with digital dialing on both channels. See Section 3.2.11

It is recommended that all regions having a hospital radio base station

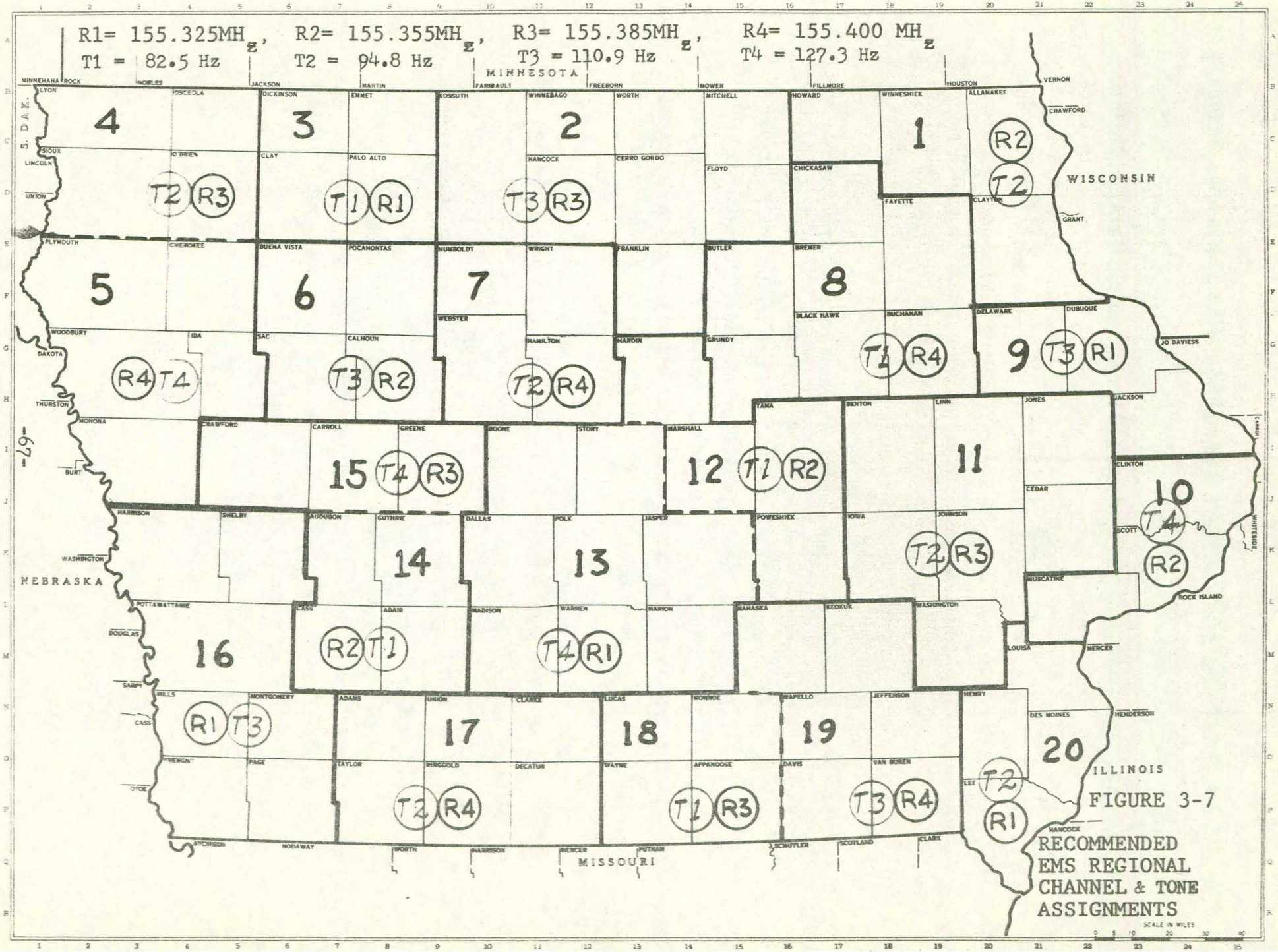


FIGURE 3-7

RECOMMENDED EMS REGIONAL CHANNEL & TONE ASSIGNMENTS

STATE COUNTY OUTLINE MAP

operate the facilities on the R channel. Refer to Section 3.2.10 for recommendations of regions where this exists.

Region 11 (Comm Center - Cedar Rapids) has a special situation and will operate on 155.385 MHz (Channel R3) because the University of Iowa Medical Hospitals and the Veterans Hospital are located twenty five (25) miles distant with University Hospitals utilizing a radio facility operating on 155.340 MHz. This operating frequency arrangement is necessary because a large number of patients are delivered daily from all parts of Iowa and from adjacent states to these medical facilities. (See Section 3.7).

Region 13 (Comm Center - Des Moines) currently has a large private ambulance service operating on 155.325 MHz (Channel R1). This frequency has been selected as the regional frequency to reduce the volume of message traffic on 155.340 MHz generally used by ambulances bringing patients into Des Moines from other areas both inside and outside the region. Other regions utilizing two channels will benefit to a lesser degree initially but as the system becomes fully equipped, message traffic will grow rapidly.

The use of these regional frequencies presents a special situation with respect to existing FCC Rules and Regulations. Section 89.525 (C) specifies that "mobile systems in Special Emergency Radio Service will be restricted to the use of only one frequency ....." This EMSCS frequency arrangement will require special review and coordination by the augmented APCO EMS Frequency Coordinating Committee and requires a submission to the FCC for approval of mobile operation on both the statewide frequency when an ambulance/rescue unit is in transit outside his assigned region and on the regional frequency when in service within his assigned region.

PRIVATE AMBULANCE USE OF RADIO FREQUENCIES

Private ambulances participating in EMS may be licensed to carry radio equipment for communication on the assigned SERS frequencies when they are operating in conjunction and in cooperation with the regional medical facilities and Comm Center (FCC Rules and Regulations Section 89.525 (f) (17).

If private ambulance services require radio communications directly with their own operations center headquarters, it is recommended that they be licensed by the FCC for operation on one of the Industrial Radio Service frequencies under Part 91. Such mobile operation will probably require a separate set of radio equipment in the ambulance. Communications via the Comm Center to the ambulance operations center is expected to suffice for most services.

It is recommended, however, that no ambulance service either public or private be allowed to operate a base station on the assigned statewide or regional EMS frequencies unless it is the Comm Center for that region. This obviously does not preclude the monitoring of the EMS frequencies, if that is desired.

MUTUAL AID - FIRE FREQUENCY

Channel D (154.280 MHz) is a statewide fire mutual aid frequency used by a number of ambulance/rescue units which operate in conjunction with a fire department. In those regions where this channel is widely used or when its usage increases, the Comm Center and some hospitals in that region may find it desirable to monitor and/or communicate on this channel.

3.2.8 RADIO PAGING

Radio paging is an "optionally recommended" EMSCS requirement. That is, the primary functioning of the EMSCS does not depend on the use of radio paging. However, the efficient dispatch of hospital cardiac arrest teams and ambulances/rescue units may require radio paging of their emergency personnel. Therefore, it is operationally desirable to provide radio paging equipment at certain hospitals and at certain ambulance operations centers in the regions. The power output and range of such paging transmissions must be limited to a radius of ten (10) miles or less from a non-Comm Center installation. Paging on the SERS channels from the Comm Center of facility emergency personnel is allowed, for interference can then be controlled adequately.

EMERGENCY MEDICAL SERVICES PERSONNEL

It is recommended that the radio paging of EMS personnel take place on the statewide base-to-mobile frequency (Channel A) or on the four (4) designated regional channels and that such activity should be limited to paging EMTA's, other ambulance/rescue unit emergency personnel and to hospital cardiac arrest teams. The latter teams can be included in the paging function on this frequency, inasmuch as they are paged infrequently and the messages are very short, thereby contributing a minimum amount to the channel message traffic loading. Paging on these frequencies will be performed only by the Comm Center dispatcher and should be limited to ten (10) different paging codes to reduce the potential interference of this service.

OTHER MEDICAL AND HOSPITAL PERSONNEL

It is recommended that administrative radio paging or communications for other medical and hospital personnel from the Comm Center base or remote base station be conducted on a separate non-SERS frequency (or low-band SERS for one-way paging). This activity can include two-way communications

and/or one-way paging for hospital personnel, such as physicians, nurses, administrators, maintenance men and guards, as deemed necessary. However, these local communications or paging activities should be conducted using an antenna height and/or radiated signal power which will provide a radius of coverage of approximately ten (10) miles surrounding a typical Iowa hospital/community. This will greatly reduce the possibility of interference between those functions using the same radio frequency in the separate communities. Hospitals now performing these functions on one of the SERS frequencies should not be requested to alter their equipment until some compelling reason (e.g. interference with ambulance communications) comes to the attention of the Iowa SERS coordinating committee (APCO).

The FCC has under consideration (Reference 10) Docket 19654 under which it is proposed to allocate 157.450 MHz to Special Emergency Radio Services for medical paging systems in hospitals. Several types of available equipment will permit one-way paging transmissions on this frequency allowing use of the same equipment as for SERS radio communications. In the case of two-way paging operations it will be necessary to install a separate receiver on 157.450 MHz at the Comm Center or at a hospital/ambulance facility.

Should the FCC not approve the use of 157.450 MHz for paging in hospitals, it is recommended that the SERS (high-band) frequency of 155.295 MHz (Channel P) be allocated for hospital, medical and ambulance personnel paging subject to the restrictions of the antenna radiation height and transmit power output limits of Section 3.2.2.

Four separate SERS low-band VHF frequencies are now available for one-way paging from hospitals. These frequencies are 35.64, 35.68, 43.64, and 43.68 MHz. It is recommended that their use in Iowa be coordinated by APCO (See Section 3.2.7) and that assignment of these frequencies be in accordance with a four-frequency geometric assignment plan developed for the prevention of interference between the facilities involved. It is important to note that paging activities on these low-band SERS frequencies will require a separate radio transmitter and antenna from that used in the EMSCS.

3.2.9 MEDICAL DATA TELEMETRY - UHF

Medical data telemetry in this report, refers to the act of transmitting a patient's EKG from some remote or mobile location by radio or telephone to a hospital for medical analysis. The importance and use of medical data telemetry from ambulance or portable equipment will increase in the future as the EMTA training and legislative actions permit them to administer medication when in direct communication with a doctor.

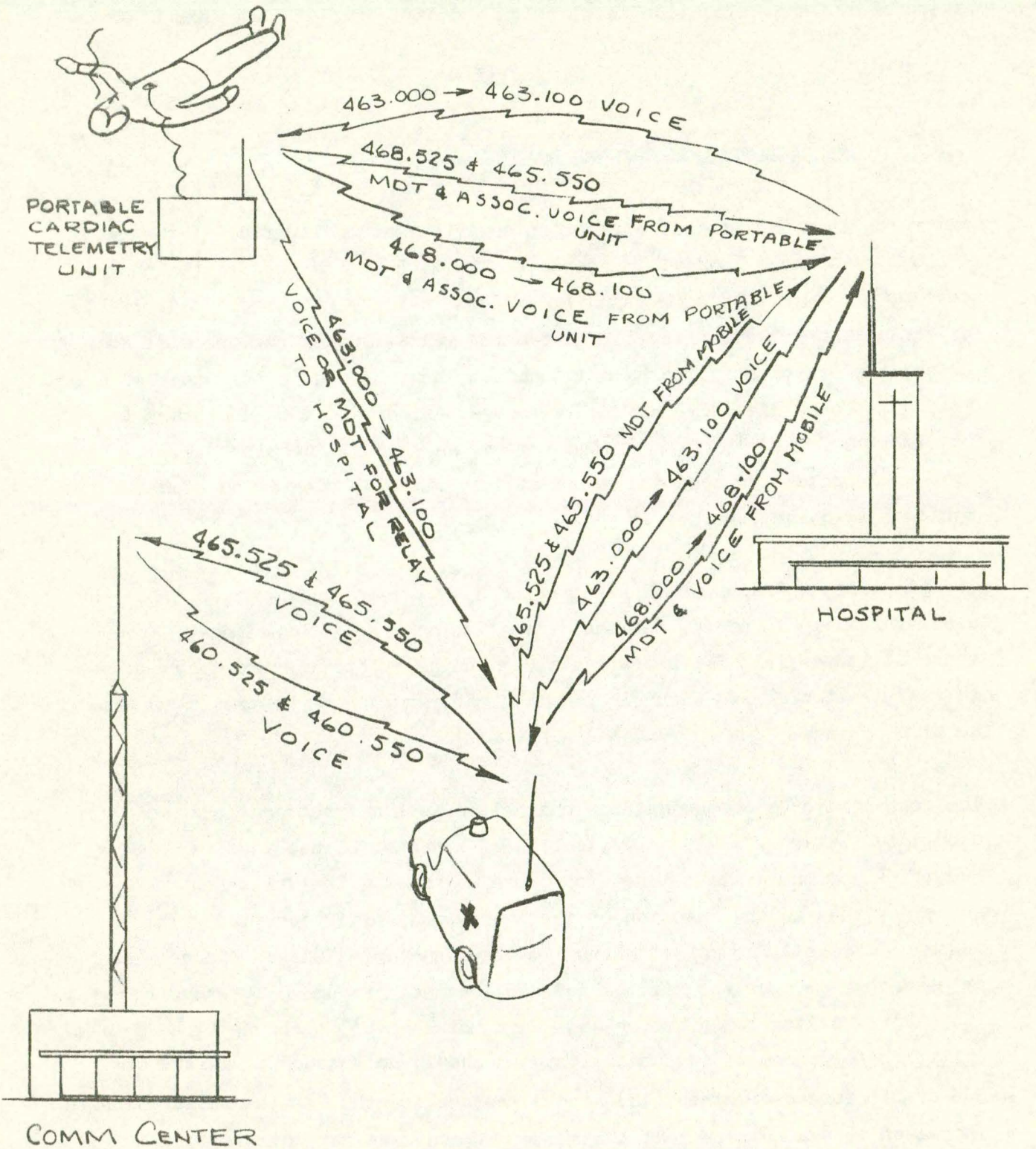
In 1972 the FCC restricted medical data telemetry to seven (7) pairs of frequencies in the UHF SERS band. These frequencies and their uses are listed in Appendix A and are shown diagrammatically in Figure 3-8. Presently, no medical data telemetry transmissions are permitted on high-band VHF frequencies. This means that if ambulance or rescue unit vehicles are to have a portable medical data telemetry capability they must also be equipped with a UHF repeater, a portable cardiac monitor and a two-way voice transceiver in addition to the VHF radio voice communication equipment complement. The Comm Centers and hospitals must also be equipped with corresponding UHF equipment.

The restriction of medical data telemetry to UHF frequencies is probably correct for large metropolitan areas but is of questionable necessity in largely rural areas, like Iowa, since UHF has approximately thirty (30) percent smaller reliable signal coverage area than high-band VHF signals. Furthermore, the use of pairs of frequencies to accomplish medical data telemetry and coordinating voice transmissions from an ambulance/rescue unit is also a questionable necessity for simultaneous voice and data transmissions are technically feasible. The use of portable UHF equipment for transmission from the patient to the ambulance for relay to the hospital would, however, be necessary.

Letters requesting reconsideration of this seemingly unnecessary and uneconomic operational restriction have been sent to the FCC by the Department of Health, Iowa Hospital Association and at least one county operated ambulance service. To date these have produced only negative responses from the FCC. It is recommended that the petitioning of the FCC to

FIGURE 3.8

MEDICAL DATA TELEMETRY SYSTEM ON UHF SERS FREQUENCIES



authorize high-band SERS medical data telemetry be continued. It is also recommended that close contact be developed with other largely rural states and encouragement to petition for the telemetry permission as they become aware of the same situation in planning and implementing their EMSCS.

3.2.10 MESSAGE TRAFFIC CHANNEL LOADING

After the installation and during the early operational period of the EMSCS, the message load will increase. The high injury density regions will develop a large traffic on channel A. This increase may exceed a desirable criteria in a period of one (1) to two (2) years. Other regions will not exceed the criteria for perhaps a decade. When the system response for a region is found excessive and fails to meet criteria, it is necessary to utilize the frequency plan for the region, as shown in Section 3.2.7. This plan anticipates the load and recommends initial implementation of certain regional frequency channels.

The figures and graphs which are presented in the following pages allow for a careful analysis of the regional situation as conditions change. From these it is possible for the state and planning authorities to recommend the utilization of two channels and that major receiving hospitals acquire a radio system.

The term load of a communications channel defines a fractional channel occupancy (Erlang). This is a function of a number of messages per hour multiplied by the average length of these messages. The Erlang channel occupancy then is the fraction of the hour a channel is occupied with message traffic. Figure 3-9 shows the dependency of a single channel load on messages per hour for various message lengths. Figure 3-10 shows the two channel system load for the same circumstances. The channel load system criterion for a one or two channel system should not exceed a maximum of 50% of 0.5 for an eighteen (18) second message length. As the message length increases it can be seen that the number of messages per hour rapidly diminishes for a given channel load.

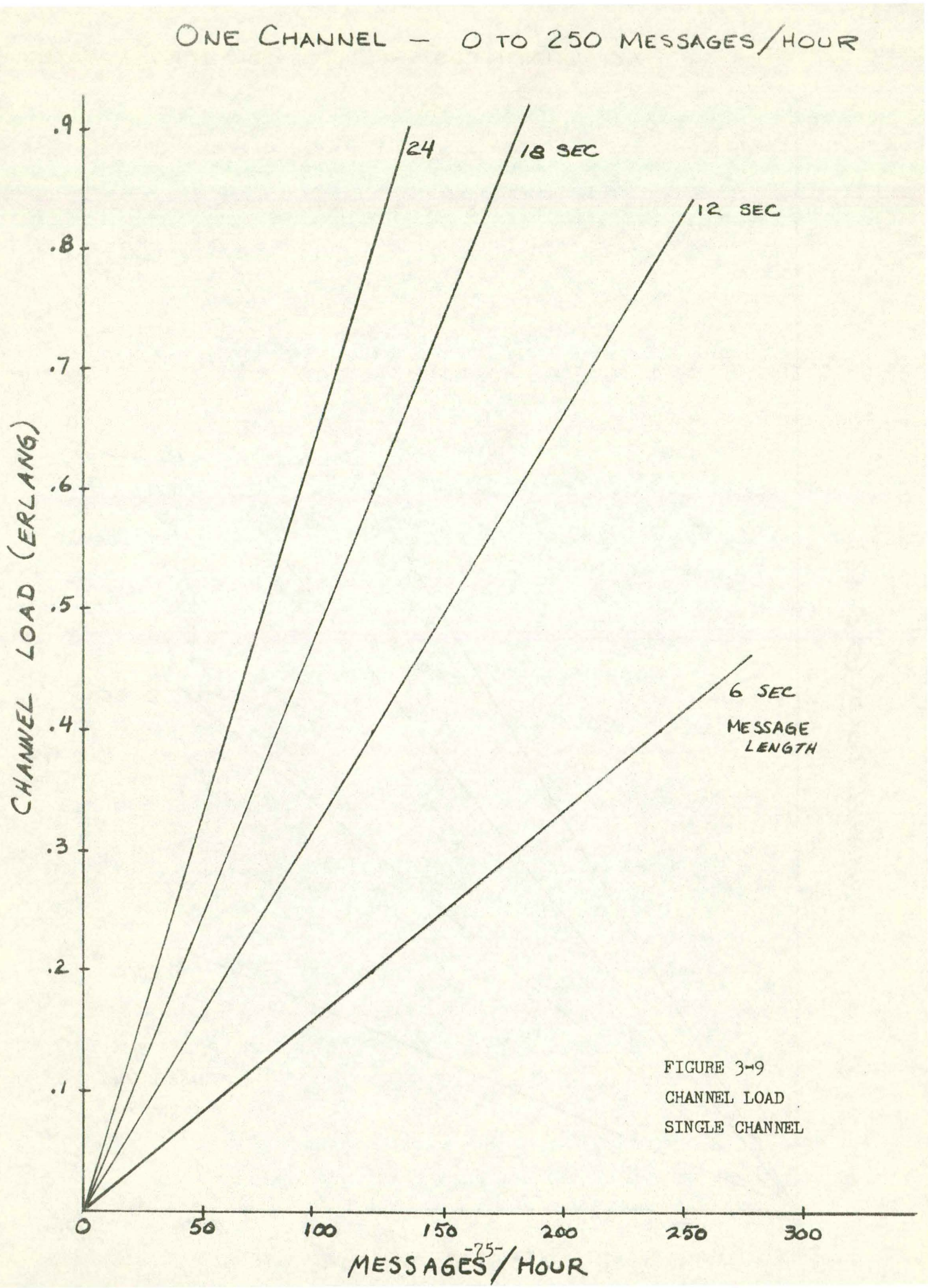


FIGURE 3-9
CHANNEL LOAD
SINGLE CHANNEL

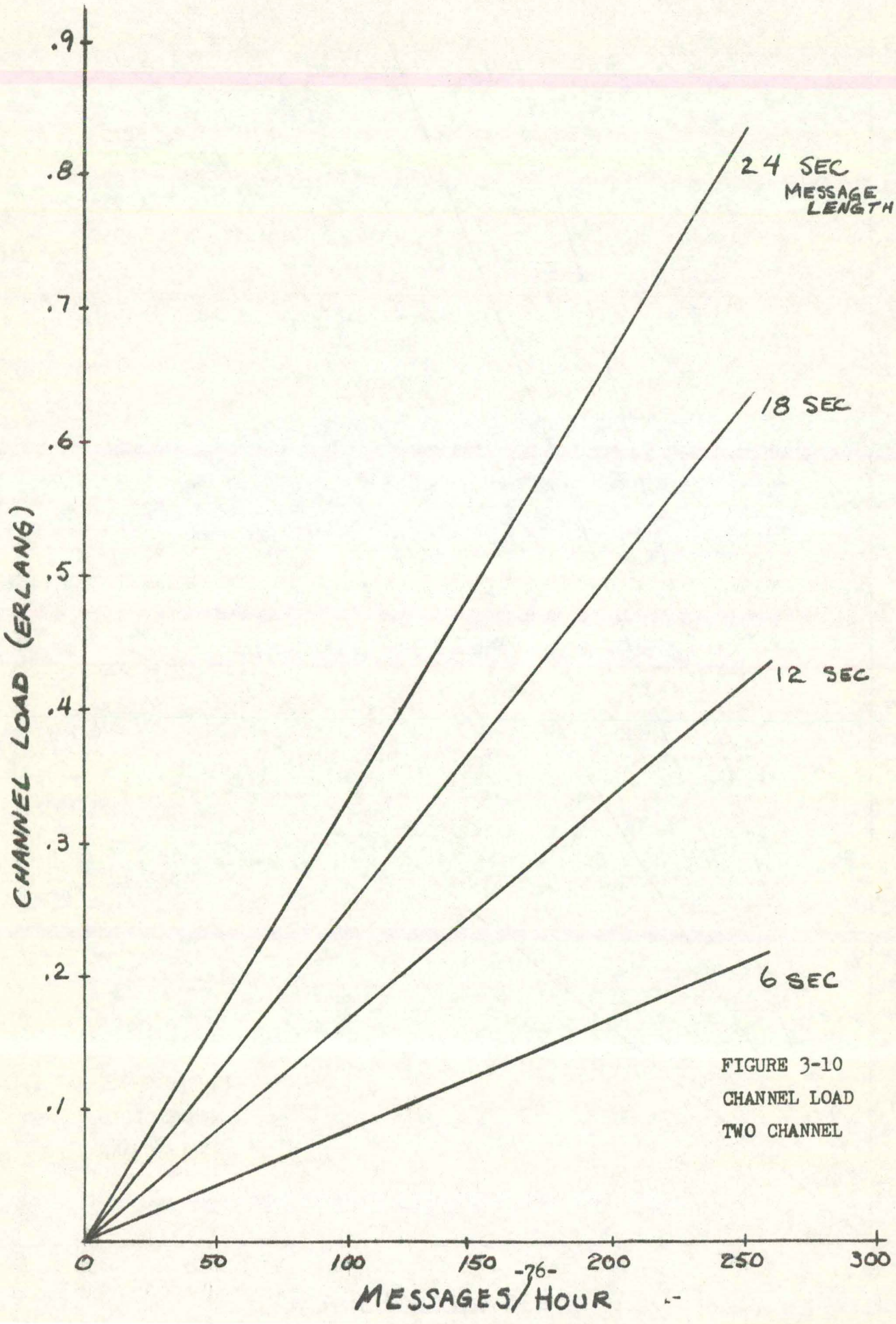


FIGURE 3-10
CHANNEL LOAD
TWO CHANNEL

The wait time for a user to find a clear communication channel is a very important parameter in providing satisfaction and effective use of a communication system. Figure 3-11 and 3-12 are indicative of the wait time which may occur for one and two channel systems respectively versus the number of messages per hour and for message lengths of 6, 12, 18 or 24 seconds. The waiting time criterion for a responsive system should not exceed a message length.

It may be assumed that the average message length will be between twelve (12) and eighteen (18) seconds, therefore a single channel system can conceivably carry peaks of one hundred (100) messages per hour without exceeding the channel load or wait time criteria.

At approximately one hundred eighty (180) to two hundred (200) messages per hour even the two-channel system traffic may at times exceed the load and wait time criteria established. On the basis of survey information in the State of Iowa, this should not become a problem for many, many years, even in the busy regions, since peak EMS communications generally are less than one hundred (100) messages per hour.

Interference of hospital-to-ambulance communications or from Comm Center-to ambulance operations in different parts of the region may cause a need for a second channel before the message traffic conditions exceed the traffic criterion, for in a given region or from region-to-region, interference can be considered a part of message traffic load. In several regions, this report recommends a second channel be implemented when the system is first installed when the required services for ambulance and emergency room radio links can create a message traffic rate of twenty (20) per hour.

The criterion for overall EMSCS delay time for emergency calls should never exceed two (2) minutes. Delay time is the elapsed time between the receipt of a citizen request for aid until the time an ambulance operations center is notified and committed to action.

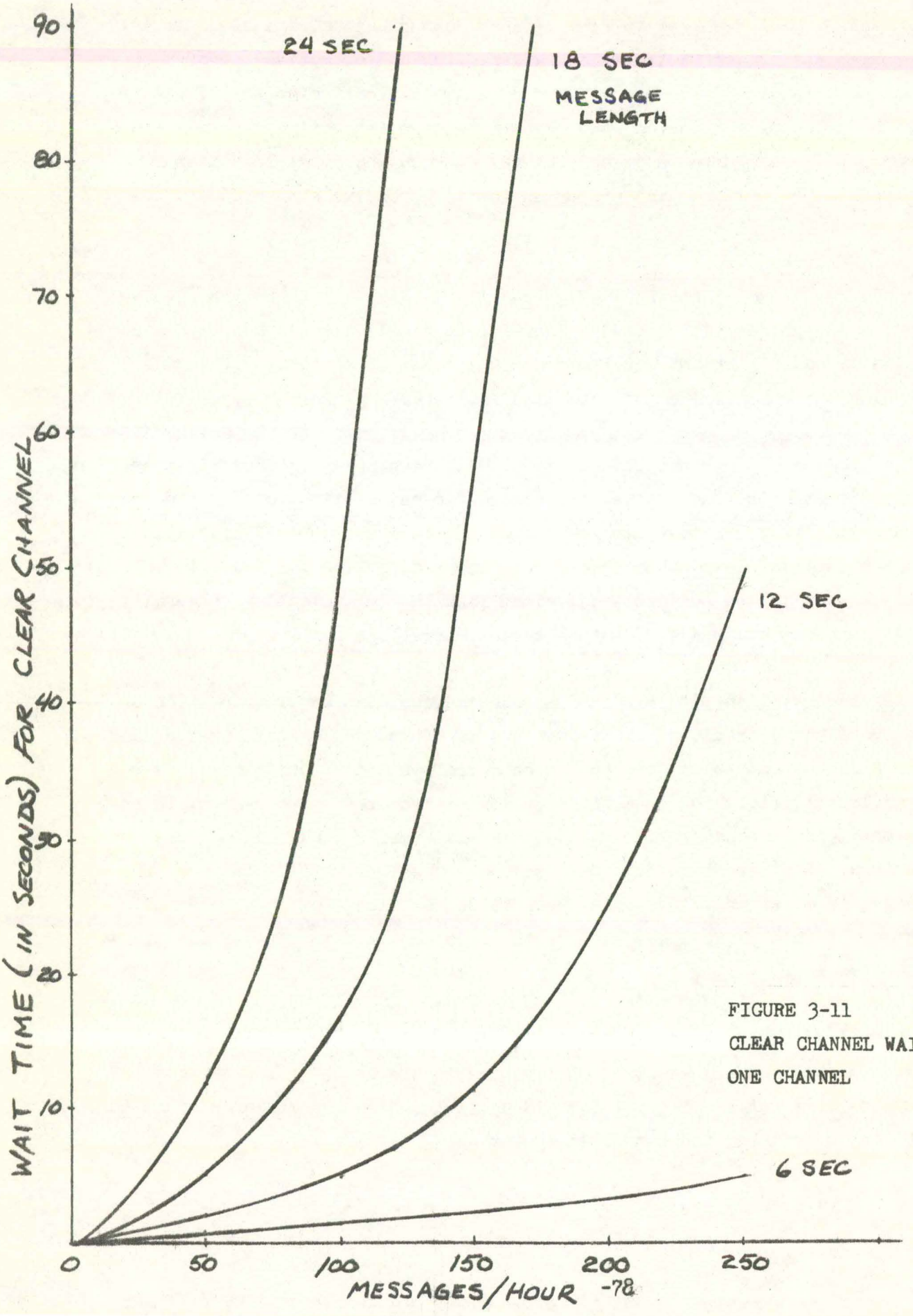


FIGURE 3-11
CLEAR CHANNEL WAIT TIME
ONE CHANNEL

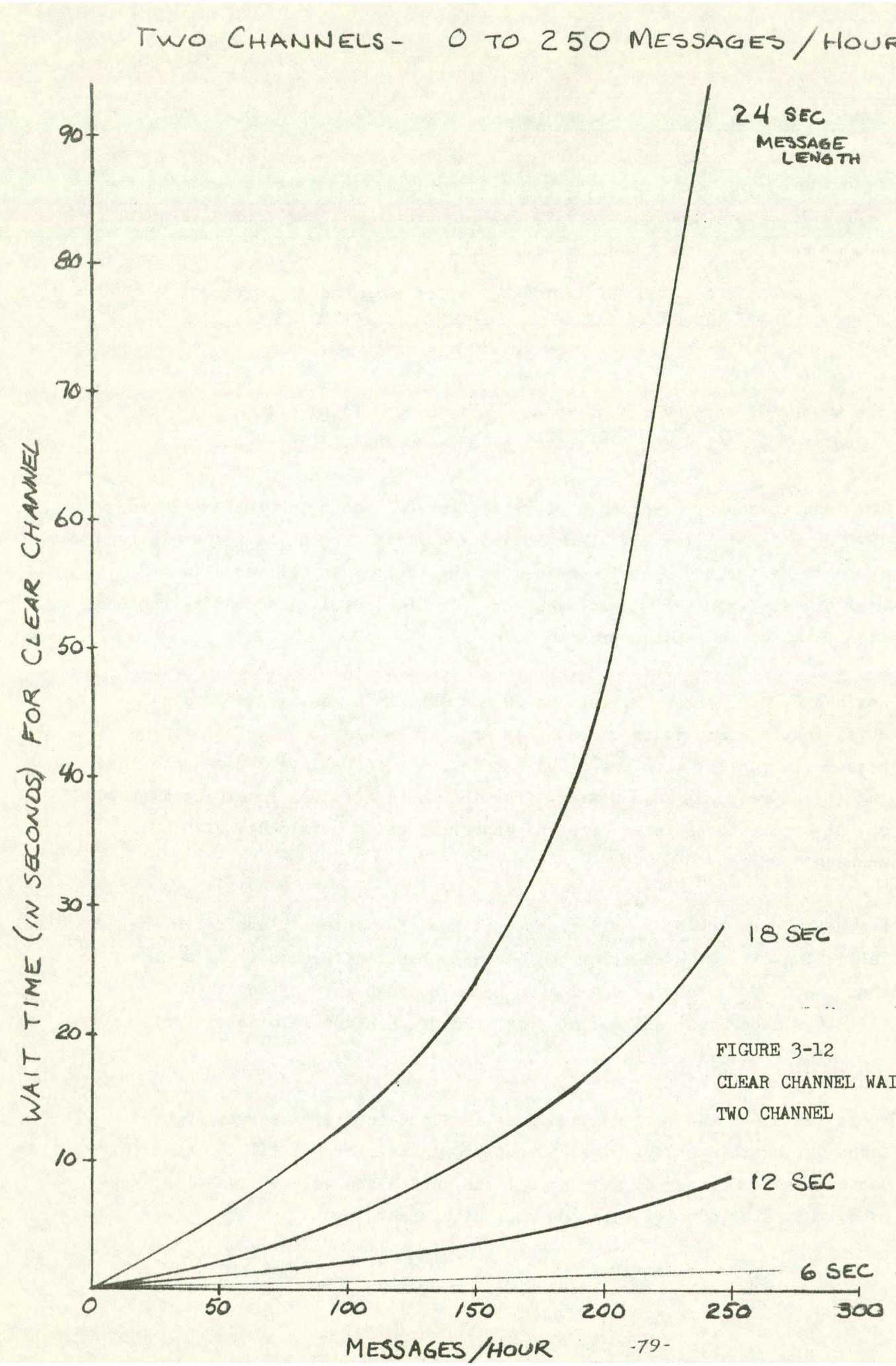


FIGURE 3-12
CLEAR CHANNEL WAIT TIME,
TWO CHANNEL

MESSAGE TRAFFIC ANALYSIS BY REGIONS

From the survey portion of the study data, it is possible to estimate the present time average message rate for each regional Comm Center were it now operative. This was computed from:

$$\frac{\text{Yearly \# of EM deliveries per region} \times \text{\# of messages transferred per delivery}}{\text{\# hours in year}}$$

The number of message transfers per delivery was found during the study to be eighteen (18) for a hospital based ambulance. (Reference 5.)

The results show a wide range of rates from 0.28/hour in District 14 to 12.5/hour in District 11. Peak to average ratio of message rates has been found to be about 5.0 to 1 considering the patient is delivered in 1/2 hour or less from the time of request. In high population density regions this peak figure could approach 150/hour.

Regions 5, 8, 10, 11, 13, 16, and 20 now exhibit a message flow rate sufficiently great to recommend that the larger hospitals in the region have radio contact with the ambulance in order to relieve the message loading at the regional Comm Center. For the most part, the remaining districts do not appear to be in any present danger of being overloaded with EMS message traffic.

A message rate per hour criterion to be used for future planning in establishing a radio system for hospitals or hospital groups is at a time when the Comm Center for the region has a message rate of forty (40) to fifty (50) messages per hour at peak load or when the related criteria are being exceeded regularly.

Table 3-3 shows the peak message/hour load obtained from survey figures taken during this study. These are approximate, for not all the emergency admissions were reported and not all the admissions were emergencies, however, they are indicative of the real situation.

TABLE 3-3 REGIONAL PEAK MESSAGE TRAFFIC/HOUR

Region	EMS Deliveries	Peak Messages/Hour
1	881	9.05
2	2463	25.4
3	1339	13.75
4	224	2.3
5	1672	17.2
6	347	3.6
7	1312	13.5
8	3077	31.6
9	1935	19.9
10	2031	20.8
11	6092	62.6
12	1245	12.8
13	5430	55.8
14	134	1.4
15	367	3.77
16	2247	23.1
17	515	5.3
18	180	1.8
19	293	3.0
20	2712	27.8

3.2.11 SELECTIVE CALLING

During the on-site survey, it became evident there was a general need to eliminate the unwanted communications "noise" from the emergency room radio monitor. This criterion combined with the following additional operational criteria requires a combination of digital dialing and tone squelch:

1. Alert/call only the facility with which communication is desired.
2. Makes necessary dialing a facility only once per message from the ambulance even though the message may consist of several transmissions.
3. Allow meeting the FCC Rules and Regulations, Part 89.523(b) which requires the monitoring of a channel prior to transmission on it.
4. Provide a future system expansion to allow message routing through a Comm Center or a hospital base station message routing system.

These selective calling techniques combined with a relatively simple procedures provides an ability to meet all the preceding criteria with relatively low cost.

DIGITAL DIALING

Digital dialing when used on radio links is very similar to the function of a dial telephone. A series of audible tone pulses are transmitte d which correspond to the digits of the dialed number. The receiver has a pulse decoder which responds only to its unique number, the response to a matching pulse sequence (number) is signalled by both an audible sound and an indicator light.

Upon receiving a positive signal the handset or microphone can be taken "off-hook" which connects the receiver output to the earpiece or loud speaker. The operator now may transmit an answer by depressing the push-to-talk transmit switch.

When the message sequence is completed, the handset may be returned to its cradle and the "on-hook" condition restored. This breaks the connection

and requires redialing to initiate a message.

During the period when both ends are off hook and the transmit switch is off, both the receivers provide an output of any other signals on the channel regardless of the dial code used. This can allow unwanted transmissions to be heard. (Reference 11).

It is recommended that digital dialing be used in the EMSCS to initiate radio communications with system base stations. Thus, any communications from a mobile radio unit (ambulance, rescue unit, etc.) to any base station or between base stations of the EMSCS must be initiated by dialing a unique dial code at the calling station. An ambulance always operates with its radio turned on in a monitor mode and therefore does not need a unique dial code. The ambulance radio audio output carries all activity on the channel. It is recommended for dialing simplicity and to make them self-reading that the dial codes used in the EMSCS be four-digits in length and be established in the following manner:

1. The first two (2) digits will be identical to the number of the region in which the called station is located. Region numbers smaller than ten (10) will be preceded by a zero. (See Section 2.0 for region number designations.)
2. In a similar manner the third and fourth digits will specify the station facility being called according to the following list:

   01 - - - - Comm Centers
   02 through 10 - Special Situations (The special Comm Center in Iowa City operating in conjunction with the University Hospitals is assigned dial code "1102" in order to identify it separately from the Region 11 Comm Center in Cedar Rapids.)
   11 through 29 - Hospitals
   31 through 59 - Ambulance Services
   61 through 69 - Fire Departments
   71 through 79 - Law Enforcement Agencies

88 - - - Region "ALL HOSPITAL CALL"

99 - - - Regional "ALL CALL"

3. In addition, dial code 9999 will be an "ALL CALL" to all EMS radio stations within communication range of the calling station. Some typical digital dial codes are:

0501 - - - Region 5 Comm Center, Sioux City

0711 - - - Region 7, Hospital

2031 - - - Region 20, Ambulance Service

1361 - - - Region 13, Fire Department

1071 - - - Region 10, Law Enforcement Agency

TONE CODED SQUELCH

Tone coded squelch (TCS) is a method of selective calling in which a sub-audible tone is transmitted continuously be a station during all of its transmissions. Presence of the tone is detected in the called station receiver and allows the voice output to be connected to the earpiece of the handset or to the loudspeaker. Its use requires that the transmitter of each station be equipped with selectable tone generators and that the receiver contain a tone detector specifically adjusted for the assigned tone of the facility.

Tone coded squelch is particularly useful when a number of users share the same radio channel (frequency) and do not wish to hear the other's communications. (Reference 11) In the EMSCS each mobile radio will be equipped with a tone generator capable of eight (8) selectable tones. Each base station will be equipped with a similar tone generator and a single tone detector for its assigned TCS frequency.

Operationally, the calling station operator sets the tone code selector switch to the unique tone for the station being called, lifts the desk set or microphone (off hook), listens to assure the channel is not occupied, dials the dial code for the called station and when acknowledged by it, he transmits. Note: (1) If the called station is a mobile unit,

dialing is not required, (2). The receiver having a tone code detector has an automatic tone decode disabling feature which allows the operator to monitor the channel before he transmits.

It is recommended that in the EMSCS, tone coded squelch be used to keep the Comm Center and hospital base station receivers "quiet" except for transmissions intended specifically for that facility (See Section 3.2.2).

It is recommended that a tone coded squelch regional frequency plan be used on 155.340 MHz (Channel A) statewide frequency. The TCS frequency plan will reduce the possibility of hearing adjacent region Comm Centers when they operate on Channel A. The TCS frequency plan recommended will be assigned to Comm Centers as shown on Figure 3-7. The Comm Center dispatcher will be able to monitor his regional activities on the Channel A for these communications will utilize that region's TCS frequency. Adjacent region activity can be monitored by disabling the TCS decode.

The hospital radio receivers for all channels must each have a unique TCS tone frequency assignment in addition to the digital dial code. This feature allows meeting system criteria and offers operating simplicity in the ambulance. The ambulance operator sets a TCS tone for the EMS facility he is dialing regardless of the frequency channel he uses. This simplifies his procedure although it is not always a requirement to transmit a tone. Later system additions may require the tone.

It is recommended that the seven (7) other specific tones available for use in each region have their geographical and facility assignments coordinated by the State Communications Division in cooperation with the Iowa EMS Advisory Committee from the following EIA (See Reference 8) Group B tone coded squelch frequencies and designated as shown:

Tone No.	Freq.Hz	Tone No.	Freq. Hz
1	82.5	5	146.2
2	94.8	6	167.9
3	110.9	7	192.8
4	127.3	8	225.7

Channel R in the Comm Center base station receivers will have no tone squelch decode (RF squelch only will be utilized).

AUTOMATIC MESSAGE ROUTING

The operational features of the combined digital dialing and TCS makes technically possible an automatic message routing system for the regional channel. This could be implemented at either a Comm Center or at a multiple hospital base station. An operational advantage would be gained in high traffic density regions through avoidance of the dispatcher or base station operator having to manually patch a radio call to the specific facility. Operations would proceed as though each facility had its own "party line" receiving channel. (Reference 11.)

This feature may be installed later in the life of the EMSCS and is not recommended for initial implementation for there is presently no equipment design which will perform this function as required.

EMS COMMUNICATIONS DIRECTORY

Digital dialing and tone coded squelch implementation requires a State EMSCS Communications Directory.

It is recommended that the office of the Iowa State Communications Division periodically issue an EMS Communications Directory. This directory will list and cross reference the various facility TCS tones and dial codes by city, county, region and EMS function in alphabetical order.
The directory will provide the necessary information for an ambulance driver or EMTA to establish needed communications even though operating outside of his usual region. Dispatchers will utilize the directory for

base-to-base intercommunications.

It is recommended that in the directory listing the digital dial codes and the TCS tones be combined into one numeric designation in the following order:

1. The four-digit dial code.
2. A dash to separate the two parts.
3. A single digit which represents the TCS tone in accordance with the recommended designations.

A typical example would be:

0201-3

where the "02" means Region 2, "01" specifies the Comm Center in that region (Mason City) and "3" specifies that on Channel A that Comm Center uses Tone 3 (110.9 Hz) for TCS.
Note: Region 2 is assigned regional frequency, Channel R 3.

It is recommended that all participating ambulances be assigned a four-digit numeric designator for purposes of identification in the following manner:

1. The first two (2) digits will be identical to the number of the region in which they are normally assigned. Region numbers smaller than ten (10) will be preceded by a zero.
2. In a similar manner, the third and fourth digits will specify the individual ambulance in the region.
3. This designation provides a unique code for each ambulance in the state for call identification, location and inventory.

These ambulance designations and the location of their permanent station should be given in the EMS Directory.

It is recommended that this directory also contain listings of the medical 2-codes and the standard police 10-codes discussed in Section 3.6.

It may be desirable to include in the directory, maps of the larger metropolitan areas of the state showing the main traffic arteries and the location of the various medical facilities.

3.3 SYSTEM EVALUATION CRITERIA

Methods are provided for evaluation of the EMSCS in terms of performance effectiveness and overall cost. From these two factors, a performance index or a quality factor can be computed by forming a ratio of the performance effectiveness to the system costs. When consistency is utilized in computing the terms making up the performance effectiveness and when the costs are accumulated consistently throughout the state, the quality factor ratio can be compared statewide and remain useful during the life of the system.

There are three (3) primary questions to be answered in determination of a system's performance effectiveness.

1. Does the system link those who should be served?
2. Does the system provide a user responsiveness in terms of both time-required-to-complete-a-message and the number of messages that need to be transmitted versus a number of messages which were not completed because of interference or other unreliable operations?
3. Is the system completely installed and operational in accordance with its plan?

Numerical factors can be assigned to each of several performance effectiveness terms. These numerical assignments can be based on a normalized index of measurement. In the following paragraphs several system evaluation criteria are established which may be employed by the EMS Communications Task Force and by State Communications Division personnel who are responsible for assessment of the EMSCS performance and determining its quality indices.

EVALUATION OF THE EMS COMMUNICATIONS SYSTEM PERFORMANCE

1. The EMSCS Installation Evaluation is found on the basis of a ratio:

$$\frac{\text{\# Comm Centers and remote bases planned} - \text{\# Comm Centers and remotes not installed}}{\text{\# Comm Centers and remote bases planned}}$$

This factor has a numerical quantity of one or less and is unity for a completely installed and operational system. (Note: No hospital communications systems are included, for these should be considered apart.)

2. A Comm Center Requests-Performance-Effectiveness-Evaluation can be formed based on records of the:

$$\frac{\text{\# of Requests Received Directly} - \text{\# of Requests Referred or Lost}}{\text{\# of Requests Received Directly}}$$

A second way of assessing the regional or statewide capability is to form the Telephone Emergency Service Factor ratio consisting of the:

$$\frac{\text{\# of telephone exchanges which handle and transfer EMS requests} - \text{\# of telephone exchanges which are not connected to Comm Centers}}{\text{\# of telephone exchanges which handle and transfer EMS requests}}$$

3. Another performance evaluation of importance is the Radio Operations Area Factor formed by ratio of:

$$\frac{\text{Area of the region served reliably by EMS communications} - \text{Area not served reliably by EMS Comm Center}}{\text{Area of the region}}$$

(Note: This ratio can be formed for a region or for the state to equal advantage.)

4. To assess the Ambulance Service Participation Performance a numerical ratio may be formed equal to:

$$\frac{\#\text{ of licensed or registered radio equipped ambulances} - \#\text{ of non-radio equipped ambulances}}{\#\text{ of ambulances that are licensed or registered}}$$

5. A Hospital Participation Performance Evaluation equals:

$$\frac{\#\text{ of EMSCS hospital emergency rooms} - \#\text{ of emergency rooms not linked to an EMS Comm Center}}{\#\text{ of EMSCS hospital emergency rooms}}$$

6. The Law Enforcement Participation Factor for the region or state agencies in developing communications linkages with the EMSCS can be assessed in terms:

$$\frac{\#\text{ of law enforcement agencies linked to EMSCS} \quad \#\text{ of non-participating law enforcement agencies}}{\#\text{ of law enforcement agencies linked to EMSCS}}$$

This evaluation term should consider two factors of performance:

1. Law enforcement dispatch terminal equipped with a phone patch link with the EMS Regional Comm Center.
2. Numbers of mobile units having Mutual Aid frequency EMS Channel C capability for contact with ambulance service vehicles.

EVALUATION OF SYSTEM RESPONSE

The system-response-time-to-user-requests evaluation is dependent on several factors and has elements of congestion and queuing theory involved in its analysis. Section 3.2.10 considers these factors and provides curves of performance in terms of importance to the system user. Evaluation of response time then involves usage of index factors such as time to answer an incoming request line, probability for a clear channel (channel load) in the system, message length, and wait time of users when they utilize the system. Degrading effects of interference, unreliable operations and downtime can enter into the specific system effectiveness in terms of response time and must be cared for in a manner which is separated from the standard message response terms.

Evaluation of response time can depend on several assumptions. An assumed criterion for an emergency medical communications system considers the average message length to be in the order of eighteen (18) to twenty (20) seconds. With this message length and an average channel load factor not exceeding 0.5, which means the channel is occupied 50% of the time, then approximately one hundred (100) messages per hour per channel can be transferred. With this number of messages per hour and an eighteen (18) second message length, the wait time for another user to obtain a clear channel is approximately one message length, and should not exceed twenty (20) seconds.

For use in evaluation, the Comm Center dispatch personnel should maintain records of numbers of messages per hour and the length of the messages. This will enable a specific evaluation in terms of wait time for clear channel. The evaluation method assumes the system is operating one hundred percent (100%) effective if message wait times do not exceed the twenty (20) seconds criterion, however, if the average of message wait time exceeds twenty (20) seconds, the Message Performance Effectiveness is formed:

$$\frac{\text{20 seconds (maximum wait time)}}{\text{Actual average message wait time, seconds}}$$

Note: This performance value can exceed unity and accordingly provides a weighting factor of importance in overall system effectiveness.

A criterion for the time required for an EMS Comm Center dispatcher to answer any emergency request line is recommended to be fifteen (15) seconds (three (3) rings).

Arrangements should be made with the Telco to conduct "blocked call" studies each ninety (90) days on each Comm Center's emergency lines. A report of this data should be made to the Communications Division, State of Iowa to assure each center has a capability of meeting the fifteen (15) second answer criterion.

Interference, unreliable operation producing system downtime in a given period due to operational or maintenance problems should be cared for on the basis of a normalized fractional ratio derived as follows:

$$\frac{\text{Total time in a period - Downtime}}{\text{Period Length}}$$

TOTAL SYSTEM EFFECTIVENESS

The above evaluation factors may be summed and formed into a system Total Performance Effectiveness Factor in the following way: If one assumes that all the above factors are equally weighted, calculate a total effectiveness factor by multiplying together each of the fractional values formed above. The product of these will be the total performance effectiveness of equally weighted factors.

It may be found desirable to weight differently certain factors in accordance with their effect on total system performance. A suggested method for using a variable weighting index for this is submitted as an example:

Performance Effectiveness Terms	Assumed Weighting	X	Example Performance Effectiveness	=	Weighted Performance
System Installation	2.5		.9	=	2.25
Service Requests Directly Honored	1.5		.75	=	1.125
Area Served	.8		.95	=	.76
Ambulance Participation	1		.70	=	.70
Hospital Emergency Room Participation	1		.80	=	.80
Law Enforcement Agency Participation	1		.80	=	.80
System Response Time	1		1.5	=	1.5

If these weighting factors are multiplied times the actual-experience evaluation performance term, the weighting of performance of that term can be properly related to the whole.

If each of these weighting and effectiveness factors were multiplied together, as shown, the effectiveness of the entire system would be a factor of 1.29. This may be related to a percentage effectiveness by dividing the result by 3.0, the product of the weighting factors. In the assumed figures this provides an overall effectiveness factor of 0.43. This method is perhaps the most useful and meaningful in the determination of an entire

system cost/performance quality.

COST ASSESSMENT

System installation, operations and maintenance costs should be collected for reference. Generally these may be recorded for each terminal in a region. These terminals, of course, are those of the Comm Centers, hospital emergency rooms, and the radio-equipped mobile units which are involved in the ambulance and rescue operations. The actual costs of adding terminal equipment in law enforcement can be included if done consistently throughout a region. These actual costs can then be totaled for a region to use in the region cost index. The region costs may be totaled to derive a cost index for the entire state.

While the system quality factor can be assessed on the basis of installation costs only, it is desirable to add into the cost figures some prorated time for total system operation and maintenance for a period of ten (10) years, for example. Assuming all the regions are compared on a consistent basis, they may then be compared one to the other for performance effectiveness and in terms of quality for region to region.

Note: While operational costs depend very much on the choice of Comm Center location and sharing of personnel, the maintenance cost for a public safety communications system can be estimated as 8% of the initial system cost which is adjusted each year by a 5% inflation rate.

3.4 EMSCS EQUIPMENT SPECIFICATIONS

The following equipment specifications are prepared for utilization in requests for quotations from land-mobile communications equipment suppliers. These specifications are written to allow several bidders to respond responsively to meet the requirements of the overall system.

3.4.1 COMM CENTER BASE AND REMOTE BASE STATION SPECIFICATIONS

GENERAL:

Primary Power:	117 VAC, 50-60 Hz
Frequency Range:	132-174 MHz
Circuitry:	Tubes or solid state
Number of channels	4 (remote controllable)
	Specific Frequencies: 155.340 155.235 155.XXX R channel for region 155.XXX spare
Compliance:	FCC type accepted, part 89, DOT approved.

RECEIVER:

Sensitivity:	0.4 uV for 20 dB quieting
Selectivity:	-80 dB @ ± 30 KHz (EIA-SINAD)
Intermod:	-80 dB (EIA-SINAD)
Modulation Acceptance(EIA):	± 7 kHz
Spurious and Images:	-90 db
Frequency Stability:	± 0.0005% from -30°C to + 60°C
Squelch Types:	Carrier plus tone-coded squelch using one of eight (8) possible EIA tone code frequencies
Digital Decoder:	4-digit decode; pulse train of 1500 Hz ± 22 Hz of 10 to 20 pulses/second. Any reset required shall be automatic with handset or the equivalent of going "on-hook".
Squelch Sensitivity:	0.25 uV at threshold

RECEIVER: (Continued)

Audio Response:	Within +1 and -3dB of 6 dB/octave de-emphasis characteristics (600 ohms balanced)
Audio Output(3.2 ohms):	5 watts at less than 5% distortion

The foregoing description is for a single receiver. The initial implementation of a base station will require two receivers which at a later date can be modified by adding a crystal for a second frequency (in each receiver) which will be scanned at a rate not to exceed 4 times/second for incoming signals.

	Priority	Secondary
Receiver No. 1 *	155.340	155.235
Receiver No. 2	155.XXX **	155.XXX (spare)

TRANSMITTER:

Power Output:	100 watts into 50 ohms
Spurious and Harmonics:	-80 dB
Frequency Stability:	$\pm$ 0.0005% from -30°C to +60°C
Modulation:	16F3 $\pm$ 5 kHz for 100% @ 1000 Hz
Audio Response:	+ 1 -3dB of 6 dB per octave pre-emphasis characteristic
Hum and Noise Level:	-50 dB
Audio Distortion:	Less than 5%

* Tone coded squelch required

** One of the following: 155.325, 155.355, 155.385, or 155.400 MHz

ANTENNA COUPLING UNIT:

The antenna coupling unit is required when more than one receiver is connected to the same antenna to prevent the loss of signal to the receivers. The coupler, in effect, provides amplification to make up the losses resulting from shunting the additional receiver across the antenna feed line.

Operating Range:	150 - 160 MHz
Number of Receivers:	Up to four (4)
Minimum Bandwidth:	250 kHz on either side of center frequency (155.280 MHz) with no degradation of receiver performance. *

* This coupler is adequate for SERS frequencies. Should a frequency outside of the coupler range be required for monitoring, for example, a fire or law enforcement frequency, a separate antenna or a wider band coupler would be required.

EMERGENCY POWER SYSTEM:

If emergency electrical power is not available at the place of installation for the Comm Center or the remote base station, an LP gas power motor-generator plant is required to permit continued operations under disaster or emergency conditions. Equipment to be powered by the emergency electrical generating system has been confined to the radio transmitter and receivers, the remote control for these, the console, and the emergency lighting for the operator.

Power capability:	2500 watts for towers having a height less than 200 ft; 4000 watts for towers requiring lighting.
Voltage:	120 VAC
Frequency:	60 Hz
Phase:	Single
Load Transfer:	Automatic motor start with utility power failure. Optional automatic retransfer of load to utility power upon its restoration.
Crankcase heater with thermostat option:	To be used if power unit is installed in unheated enclosure.
Starting Battery:	Battery shall be trickle charged from commercial power to ensure fully charged battery for automatic motor-generator starting.
Enclosure and Fuel Tank:	A suitable enclosure for the power unit shall be provided. As a minimum it should provide shelter from precipitation and have reflective surface to sunlight. Ventilation provided by a thermostatically controlled fan shall be included. A fuel tank shall be located within the enclosure and have the capacity sufficient to run the emergency power system for a minimum period of 24-hours. It is recommended that the fuel be a liquified gas petroleum product.

ANTENNA FOR BASE STATION: (4 types of antenna)

Electrical Data

Frequency Range:	150 - 160 MHz
Bandwidth:	10 MHz
VSWR:	1.5 to 1 or less
Nominal Impedance:	50 ohms
Gain (over half-wave dipole):	
Bi-directional pattern:	3.6 dB (DB-214 or equivalent)
Omni pattern:	6.0 dB (DB-224 or equivalent)
Offset pattern:	9.0 dB (DB-225-2 or equivalent)
Semi-circular pattern:	5.0 dB (DB-225-2 or equivalent)
Maximum power input:	500 watts
Lightning protection:	Direct ground

Mechanical Data:

Material:	1. Aluminum for masts and radiating elements 2. Mounting clamps - steel,(stainless or protected from dissimiliar metal errosion)
Maximum exposed area (flat plate equivalent):	Less than 3.5 $ft.^2$
Wind rating:	Survival (w/o ice) 100 mhp. Survival (1/2" radial ice) 74 mph.

ANTENNA TRANSMISSION LINE:

If transmission line length does not exceed 150 feet, use 1/2 inch diameter, foam dielectric, cooper conductor, polyethylene jacketed coaxial cable or equivalent. For transmission line exceeding 150 feet in length use 7/8 inch diameter (same as above material) coaxial cable or equivalent.

Loss characteristics @ 152 MHz not to exceed:

1/2 inch: 1.06 dB per 100 ft.
7/8 inch: 0.57 dB per 100 ft.

Installation kit for coaxial line should be obtained from the coaxial line supplier and include the following:

(1) Suitable connectors to mate with antenna and rf equipment
(2) Tie wires for securing coax to the tower
(3) Polyethylene tape
(4) Tube of silicone for waterproofing connectors

ANTENNA TOWER:

Height:	40 to 320 feet (See Table 3-1)
Supports:	Guyed
Wind Loading Capability:	Must comply with the appropriate sections of EIA specifications RS-222-A
Material:	Tubular steel
Finish:	Hot-dipped galvanized (after fabrication) with a minimum of 2 oz. of zinc/ square foot

1 Note: All accessories for roof mounting (if possible) guying and lighting are to be included in the pricing.

2 Note: Antenna height is a critical item and should be established by a reputable engineering firm which has the necessary experience in propagation prediction analysis to make an analytic recommendation for the actual site to be used.

3 Note: For cost estimation (as used in Section 4 of this report) purposes a tower construction without microwave antenna capability was used.

4 Note: Tower lighting and Painting (Ref: FCC Rules, Part 17, Subpart C) Lighting and painting is normally required by the FAA when antenna structures exceed 200 feet in height above ground.

The Federal Communications Commission reviews all applications for proposed antenna structures with respect to possible hazard to air navigation and will inform the applicant whether there is a requirement that the applicant file a Notice of Proposed Construction or Alteration (FAA Form 7460-1) with the Federal Aviation Administration. Painting and lighting specifications will be assigned by the FCC to individual antenna structures as a part of the notification and approval cycle. (See Appendix B.)

PAGING EQUIPMENT (OPTION):

GENERAL:

Frequency:	The 155.340 MHz frequency is reserved for EMS communications with ambulances and limited to Comm Center paging for EMS personnel. When paging equipment is used with a hospital based radio station, the transmitter carrier frequency shall be 157.450 MHz channel currently under FCC consideration or 155.295 (Channel P) if the rule making for use of 157.450 MHz is not approved.
Circuitry:	Solid State
Number of tone coded channels:	20 min.
Coding:	2-tone sequential; tone range 288.5 - 1433.4 Hz, tone spacing 2.8%
Option 1A	Tone alert only
Option 1B	Tone and voice

RECEIVER ("PAGER"):

Field Strength Sensitivity:	20 uV/meter -20 dB quieting 5 uV/meter-paging
Frequency Stability:	$\pm$ .0025% from -10°C to +50°C referenced to +25°
Spurious and Image Rejection:	At least 40 dB
Battery:	Nickel-cadmium (rechargeable)
Size and Weight:	Compatible with wearing or clipping to shirt or coat pockets, i.e. approximately 4-1/2" high x 2-1/2" wide x 3/4" thick.
Decoder:	See general information above

ENCODER: (Paging Equipment, continued)

Tones:	5 basic tones (in range 288.5 - 1433.4 Hz spaced 2.8%) allowing 20 channel codes
Power requirements:	115 VAC, 50-60 Hz
Tone Output:	Adjustable, 0-1 volt across 600 ohms

BATTERY CHARGER:

(1) Single unit, 14 ma. 12-hour charge cycle
(2) Multiple unit charger for simultaneous charging of 5 units

3.4.2 CONTROL CONSOLES FOR COMMUNICATIONS CENTERS

3.4.2.1 Communications Center With Local Base Radio Station:

3.4.2.1.1 Type of Control:

Even though the radio station is locally controlled, it is recommended that a tone control console be used for future flexibility of location changes. No DC path shall be required. The scheme used shall be one which does not permit false commands to be sent and have sufficient capability to control the four frequency transmit and receive station.

Control tones shall be momentary (not to exceed 200 ms in duration) except for a push-to-talk control tone which shall be continuous during transmitting period. A notch filter shall be used to suppress this control tone to preclude loss of intelligibility of the voice transmission. Expansion capability shall be possible to permit a minimum of two additional control functions.

3.4.2.1.2 Transmit Frequencies:

Initial system will require that three (3) transmit frequencies be controlled for each remote base. The remote control console shall be capable of being expanded to a total of our (4) transmit frequencies.

3.4.2.1.3 Receiver: Audio and Control:

Initial system implementation will require that three (3) receiver channels and tone squelch or digital decoder disable circuits be routed to Comm Center console for each installation. This shall be capable of being expanded to four (4) receiver channels at a later date. Partial audio muting shall be provided on all selected receiver outputs. Four-wire audio circuitry or equivalent shall be used to permit separate audio paths for each receiver in the two receiver installation. A visible indication shall be provided on the operator console for identifying the receiver channel in which a signal is present.

3.4.2.1.4 Transmit Audio:

Compression amplifiers shall limit the audio change to no more than 3 dB at transmitter with a 30 dB input change at the control console microphone input.

3.4.2.1.5 Transmit Indicator:

Indicator lamp at control console shall be actuated by push-to-talk circuitry and be provided as required by the FCC Rules and Regulations.

3.4.2.1.6 Receiver Squelch:

A preset two-level, remotely controlled squelch shall permit receiver

operation at tight as well as threshold squelch signal levels.

3.4.2.1.7 Digital Encoder:

A digital dial encoder which provides a pulse train (10 ± 2 pps) of a 1500 Hz tone shall be an integral part of the operator console. All ten numerical digits shall be available for dial codes.

3.4.2.1.8 Digital Decoder:

A decoder disable switch shall be included on the operator console.

3.4.2.1.9 Phone Patch:

An integral part of the console shall be a phone patch which will permit a standard telephone connection to the transmitter and receiver equipment. Voice operated (VOX) relays shall control the transmitter push-to-talk circuitry and require no intervention by the Comm Center operator during the normal course of the conversation except to monitor the circuit. Output of the phone patch to the telephone line shall not exceed -9 dBm. A compression amplifier shall be incorporated which holds the input to a transmit audio circuit to within 3 dB for a 30 dB change in the output of the telephone audio. Distortion introduced by the phone patch shall not exceed 5%.

3.4.2.1.10 Base Station Monitoring:

The Comm Center console shall have indicators which show the operator the status of the following functions:

1. Emergency power cut-over.
2. Tower lights (if required) operational
3. Security violated/enclosure open

3.4.2.1.11 Mechanical/Human Factors Requirements:

Placement of controls shall not exceed the confines of an area approximately 44 inches wide by 32 inches high at a distance not to exceed 18 inches from the center of the operator's chair. Ideal panel slope away from the vertical is 20°.

Forms and files used by the dispatcher in the performance of his duties shall be located well within his reach in drawers provided in the console pedestals and under the table top.

3.4.2.1.12 Accessories:

1. Studio quality, swivel mounted, dynamic cardiod microphone.
2. VU meter to monitor transmit audio level.
3. Separate speaker and volume control for each remote receiver group. Visual indication, as previously specified, shall provide the operator with information necessary to determine which remote receiver channel has signal present.
4. Digital clock
5. Foot operated transmit switches.
6. Headset/lip microphone with cord and jack (optional)
7. A transmit counter and running time meter (to the nearest 0.1 hour) shall be connected to the push-to-talk circuit to permit message traffic loading analysis to be made.

3.4.2.2 Communications Center With Remote Base Radio Station:

3.4.2.2.1 Type of Control:

The remote controle console shall be the same as described for the local control except that it is connected to standard telephone lines - no dc path required. A Telco line, type RT, 2002, or voice grade shall be satisfactory.

3.4.2.2.2 Balance of Control Console Specification:

The remainder of the functional control requirements are the same as specified previously for the local control console.

3.4.2.3 Station Control for Multiple Remote Radio Base Stations:

The station control console for a Comm Center which utilizes two or more transmitter-receivers requires duplication of the control functions as described for the single station control. For the control of two remote (or one local and one remote) stations, the utilization of two individual tone control consoles is the least expensive and would provide the operator/dispatcher with a relatively efficient control center, i.e., no undue dispatcher physical motion is required to operate. Although there would be some duplication of functions, this is desirable for it would allow the transfer of one control console to the other position either by physical transfer or "alternate line" switching. Alternate line switching merely transfers the control console from one telephone pair used for control of the first remote equipment to the other control for the second site of remote equipment. This arrangement provides a backup configuration and permits continued operation of the primary station should a malfunction occur in its control console.

For the Comm Center with three (3) radio stations under its control, it is possible that three (3) separate control consoles adjacent to each other could be used at one operating position and still provide the operator/dispatcher with a functional arrangement. This arrangement would readily allow a division of control to permit two operators to work when traffic becomes heavy, such as, under disaster mode of operations.

There is a need, therefore, to consider the possibility for a customized control console to eliminate the further duplications of microphones (or lack of a common transmit audio line), transmitter push-to-talk circuits, digital dialers, and the like. The customized control console allows a design which would optimize the multiple control functions, the tying together of common functions, and inclusion of improved human factors involved in the control of the stations. Open-ended growth possiblities can also be incorporated in the customized console to allow for easier expansion of capability at a later date.

Initial cost of the customized control console may be higher, but it is eventually more cost effective to have the flexibility to add functions for increased EMS communication activity.

3.4.3 TELEPHONE SUBSYSTEM FOR COMM CENTER

The Comm Center telephone subsystem configuration will consist of, as a minimum, the capability to provide the following:

1. Two incoming business lines for receiving EMS requests. These requests will originate as local calls (number to be dialed as listed under "AMBULANCE" in local directory) or as telephone operator transferred requests originating in outlying areas of the region. The telephone numbers assigned for this purpose are to be the first two in a rotary sequence of ten (10) numbers to be reserved with the telephone company.
2. A second set of three (3) telephone numbers in the sequence which are on the same rotary are to be used to communicate with the hospitals in the region as well as law enforcement agencies,

fire departments, and rescue units. The last number in this group can be used by the Comm Center operator for general administrative or low priority communications. Also, these three (3) numbers should be classified as "unlisted" and made known only to the agencies requiring access to the Comm Center operator.

3. The telephone lines are terminated in a multiline instrument, such as a "Call Director" or equivalent, with lighted push buttons on all lines. Other required features are as follows:
    1. Hold
    2. Add-on
    3. Card dialer
    4. Phone patch connection interface which is transferrable to any incoming line.
    5. Tape recorder connection including "beeper" on first two lines (incoming EMS requests) of the five on rotary. One pushbutton switch per recorder which actuates the recorder for post recording through the telephone handset.
4. Optional dedicated lines may be desired for direct connection to law enforcement agencies or ambulance firms. Normally this is not necessary unless local telephone service is marginal or the message traffic load merits such service. If more than a few miles separates the Comm Center and the agencies, the cost becomes a significant factor at $3.00/mile/month plus termination charges.

3.4.4 TAPE RECORDER

A tape recorder, cassette type, connected to each incoming EMS request telephone line will provide a record for immediate or long term reference to verify information received from the requestor. The starting and stopping of the recorder should be automatic and simultaneous with the telephone handset when taken off-hook and when being returned to on-hook. In

the stopping case, an additional five (5) seconds run of blank tape will assist in the retrieval process. Post recording on the tape immediately following the actual request permits the adding of supplementary information for internal use, such as, number of ambulances dispatched, time of day, date, etc., using the telephone instrument as the recorder microphone. A high quality cassette tape recorder will be satisfactory for this purpose keeping in mind that reliability and life of the recorder may be dependent on reputable manufacturers with availability of local service and maintenance.

The starting and stopping circuitry can be procured from companies specializing in telephone attachments.

3.4.5 AMBULANCE RESCUE VEHICLE COMMUNICATIONS EQUIPMENT (SERS FREQUENCIES)

The receiver-transmitter (R/T) unit shall be a 4-channel 136-174 MHz range, with channel scan/priority lock capability. A digital dialing encoder shall be included with the control head for the R/T unit. The following are minimum requirements for specific operational functions:

GENERAL:

Primary Power:	12 VDC (negative ground)
Frequencies:	155.340, 155.475 MHz. 155.XXX (Regional Frequency)* 155.XXX (To be determined) (Rescue vehicle may utilize fire mutual-aid frequency).
Circuitry:	Solid State
Environment:	Operational temperature range -30°C to +60°C. Relative humidity of 90-95%
FCC Compliance:	Licensable under FCC Rules, Part 89
Performance Criteria:	Applicable EIA Standards shall be used to define and determine performance characteristics.

* One of the following: 155.325, 155.355, 155.385, or 155.400 MHz.

RECEIVER:

Sensitivity:	0.5 uV for 20 dB of quieting
Selectivity:	-75 dB (EIA-SINAD)
Intermod:	-75 dB (EIA-SINAD)
Modulation Acceptance:	± 7 KHz
Spurious and Images:	-85 dB
Frequency Stability:	-.0005% from -30°C to +60°C ambient (+25°C reference, ± 15% primary voltage)
Squelch Type:	Carrier with optional tone coded squelch field modification at a later date.
Squelch Sensitivity:	0.25 uV @ threshold
Audio Output:	5 watts at less than 10% distortion with 1000 Hz tone/3000 Hz deviation
Frequency Scan:	Four-frequency scan with priority selection capability

TRANSMITTER:

Power Output:	100 watts into 50 ohms
Spurious and Harmonics:	-80 dB
Frequency Stability:	± .0005% from -30°C to +60°C ambient (± 25°C reference, ± 15% primary voltage)
Modulation:	16F3 (± 5 KHz for 100% @ 1000 Hz)
Audio Response:	Within +1 and -3 dB of 6 dB/octave pre-emphasis, 300 to 3000 Hz
Hum and Noise Level:	-40 dB from desired reference level at 3 kHz deviation with 1000 Hz modulation
Audio Distortion:	Less than 10% at 1000 Hz, 60% maximum deviation.

CONTROL HEAD: (For ambulance driver operational position)

Frequency Selection: 4 channels
Squelch Control
Volume Control
Power ON/OFF switch
Digital dial unit: Illuminated (maybe separately mounted)
Scan ON/OFF and channel priority select
Carrier "ON" Indicator
Tone Coded Encoder: Shall be capable of producing from one to eight (1-8) EIA standard tone frequencies. Initial installation may be one or two frequencies dependent on facility requirements in the region with expansion possibilities to eight (8) frequencies in a field modification.

REMOTE CONTROL: (For ambulance attendant, not required in Rescue Vehicle).

Handset hook unit with volume and squelch controls
Handset with push-to-talk switch
Cabling to control head
Optional: Digital dial unit and R/T frequency selection capability
Foot actuated push-to-talk switch

ACCESSORIES:

Speaker:	Dash mount
Microphone:	Noise cancelling, hand held with push-to-talk switch
Antenna:	1/4 wave, unity gain, whip (ASP-690 or equivalent) mounted on roof center, 24 inches or more away from all lights and siren bars. Antenna to be supplied with rooftop mount and 17 feet of coaxial cable (RG-58/U).

Cabling Harness
Maintenance Manual

3.4.6 OPTIONAL LOW BAND VHF MOBILE COMMUNICATION EQUIPMENT

It is probable in some areas of the state that the existing communication links between the county law enforcement and many municipality agencies will continue to utilize 37.10 MHz. The following specifications describe a single-channel receiver/transmitter which may be installed in the ambulance as a companion unit to the high-band receiver-transmitter previously specified. Depending on the expected length of time that it will be utilized and the funds available, these units could be procured as reconditioned units from reliable sources rather than as new manufactured products.

GENERAL:

Primary Power	12 VDC (negative ground)
Frequency:	37.10 MHz
Circuitry:	Tubes or solid state
FCC Compliance:	Licensable under FCC Rules, Part 89
Performance Criteria:	Applicable EIA Standards shall be used to define and determine performance characteristics.

RECEIVER:

Sensitivity:	0.5 uV for 20 dB quieting
Selectivity:	-85 dB at ± kc (EIA-SINAD)
Modulation Acceptance:	± 7 KHz (SIA-SINAD)
Spurious and Image Rejection:	-85 dB
Frequency Stability:	± .002% over temperature range -30°C to +60°C ambient (+25°C reference)
Squelch type:	Carrier with sensitivity of 0.25 at threshold
Audio Output:	5 watts at less than 10% distortion

TRANSMITTER:

Power Output:	90 watts into 50 ohms
Spurious and Harmonics:	-80 dB
Frequency Stability:	± .002% from -30°C to +60°C ambient (+25°C reference)
Modulation:	16F3 (± 5 KHz for 100% at 1000 Hz)
Audio Response:	±, -3 dB if 6 dB/octave pre-emphasis characteristics from 300 to 3000 Hz
Audio Distortion:	Less than 5% at 1000 Hz, 60% deviation
Hum and Noise Level:	40 dB below 60% rated deviation at 1000 Hz.

CONTROL HEAD:

Provide the following controls:

Squelch

Volume

Power - ON/OFF

Transmit Indicator (red)

ACCESSORIES:

Dash mount speaker
Hand held noise-cancelling microphone with push-to-talk switch
Antenna
Cabling harness
Maintenance manual

3.4.7 REGIONAL HOSPITAL RADIO BASE STATION

A regional hospital frequently can enhance its EMS operation by installing and operating a base radio station with the capability of communicating with ambulances enroute and paging of EMS personnel. The equipment specified is purposely a low power transmit unit to limit the signal propagation range to prevent interference to adjacent parts of the region.

GENERAL:

Primary Power:	120 VAC, 60 Hz	
Frequency Range:	136 - 174 MHz	
Circuitry:	Solid state (preferred)	
Number of Channels:	four (4) transmit and four (4) receive	
Specific Frequencies:	Transmit	Receive
	155.XXX MHz	155.XXX MHz (Channel R)
	155.340 MHz	155.340 MHz
	155.235 MHz	155.235 MHz
	157.450 MHz *	157.450 MHz (Optional for hospital personnel paging)
Compliance:	FCC type accepted, Part 89	

* A 3 dB degradation in power output allowable from specified power output.

RECEIVER:

Sensitivity:	0.4 uV; 20 dB quieting
Selectivity:	-80 dB @ ± 30 KHz, (EIA-SINAD)
Intermod:	-80 dB, (EIA-SINAD)
Modulation Acceptance (EIA):	± 6.5 KHz minimum
Spurious and Images:	-90 dB
Frequency Stability:	± .0005% from -30°C to +60°C
Squelch Type:	Carrier and tone-coded squelch (squelch tone to be determined)
Squelch Sensitivity:	0.25 uV at threshold
Audio Response:	Within + 1 and -3dB of 6 dB/octave de-emphasis characteristics from 300 to 3000 Hz (600 ohm balanced output)
Audio Output (3.2 ohms):	5 watts at less than 5% distortion
Channel Scan:	All implemented receiver frequencies (up to 4) shall be scanned with the ability to preselect one frequency as priority.

TRANSMITTER:

Power Output:	50 watts into 50 ohms
Spurious and Harmonics:	More than 70 dB below carrier per EIA specification
Frequency Stability:	± .0005% from -30°C to + 60°C
Modulation:	16F3: ± 5 kHz for 100% @ 1000 Hz
Audio Response:	+1, -3 dB of 6 dB/octave pre-emphasis characteristics
Hum and Noise Level:	-50 dB below ± 3 KHz @ 1000 Hz reference level
Audio Distortion:	Less than 5% @ 1000 Hz ± 3 kHz deviation

STATION CONTROL:

Station shall be controllable from the transmitter/receiver equipment front panel as a desk top installation. A remote desk set shall be available for installation in the emergency room to provide direct communications over the transmitter/receiver and an intercom function to the operator at the main control console.

Included in the console shall be a transmit counter and a running time meter which is actuated by the push-to-talk circuit.

Station control for multiple hospital usage of one hospital based transmitter-receiver equipment is possible and cost effective by utilizing either paralleled controls or standard telephone connection via phone patch. The paralleled control provides complete control over the remotely located transmitter-receiver, but costs approximately $1,000.00 at 1973 prices plus requiring a dedicated telephone line pair from hospital-to-hospital. The alternate installation uses a standard telephone connection between the remote hospital emergency room and the hospital with the transmitter-receiver equipment. Telephone patch is used to permit communication with the ambulance from the non-radio equipped location, i.e., same as for operation between non-radio equipped hospital and the Comm Center.

Each hospital grouping requires review to select the most cost and performance effective solution to their installation.

ANTENNA SYSTEM:

The antenna recommended is a 5 dBi omni (equivalent to DB-222) mounted at 40 feet effective height. The antenna feed-line should be 1/2 inch coaxial cable with foam dielectric, copper conductors for runs not exceeding 100 feet. For longer antenna coax feeds, select a cable such that line loss does not exceed 1.0 dB.

PAGING EQUIPMENT:

See description under Comm Center equipment specification for paging equipment (option), Section 3.4.1

EMERGENCY POWER:

It is assumed that hospitals have an emergency power system and that an outlet can be provided for the radio station. Expected a.c. power requirements under transmit conditions should not exceed 500 watts.

3.4.8 EMERGENCY ROOM DESK/WALL TELEPHONE SET

The primary purpose for having a telephone set in the hospital emergency room area is to provide direct communication between the emergency room personnel and the ambulance EMT's who are bringing in the patient. Two types of desk/wall sets are available and depending on the communication links installed at the hospital, one or both are required.

For the proposed regional EMS communication system which has a centralized Comm Center with radio equipment, the normal path between any hospital emergency room and the Center would be via telephone line. Hence, the standard telephone deskset would be utilized with the recommended addition of the Telco "Spokesman" (a speaker/amplifier attached to the telephone) to permit monitoring the telephone line without holding the handset.

The second type of wall/deskset would be used when the emergency room is located in a hospital which has radio base station equipment for communicating with ambulances directly. This is actually purchased as a part of the radio system and is an extension of the primary control console located elsewhere in the hospital. The transmit indicator light on the remote

wall/deskset shall be actuated whenever the transmitter is keyed from any of the remote controls which are in parallel.

3.5 RADIO STATION LICENSING

All base and mobile radio stations operating in conjunction with the EMSCS must be licensed by the FCC under provisions of the Communications Act of 1934 as amended. These several stations will operate under the Public Safety Radio Services or Industrial Radio Services, Part 89 and 91, respectively, of the FCC Rules and Regulations.

It is recommended that all FCC licenses for Regional Comm Centers be handled by the Iowa Hospital Association with coordination provided by the Iowa APCO Frequency Coordinating Committee. These licenses will be in the SERS and cover the statewide EMS Channel A (155.340 MHz), the R Channel regional frequency (See Section 3.2.7) and the point-to-point Channel B (155.235 MHz). Included as part of the Channel A and Channel R license should be the number of ambulance/rescue units that will operate in the region under the provisions of that license.

All non-Comm Center hospitals with a radio base station transmitter operating in the EMSCS must be licensed on one or more of the frequencies assigned by the FCC for SERS. This license may be obtained by filing an application directly to the FCC but with notification to the Iowa Hospital Association and after obtaining the frequency coordination action of APCO. The SERS frequencies for which a license should be obtained should be the regional channel (R), 155.340 MHz (Channel A) and depending on the Civil Defense plan the point-to-point frequency (Channel B) of 155.235 MHz.

Refer to Section 3.2.8 if paging activities are contemplated and obtain licenses for the paging channel frequency available. A monitor receiver must be obtained for monitoring the paging channel prior to transmission.

The ambulance/rescue units which operate in conjunction with the several hospitals in a region will be licensed as the mobile units covered by the Comm Center licenses for operation on the statewide EMS Channel A and regional Channel R. These mobiles must also be capable of operation on the statewide Public Safety Mutual Aid frequency (155.475 MHz) and as a consequence must be included in the FCC license issued to the Iowa Depart-

ment of Public Safety.

If any of these mobiles are to carry transmitting equipment on 37.10 MHz they must be authorized by their local government licensee to operate as a mobile in the Local Government Radio Service. If they need to transmit on a local fire department frequency they must be included in the number of mobiles listed on the local Fire Radio Service FCC base station license. Increasing the number of mobiles associated with a particular license may require a modification of that license.

In making application to the FCC for a radio license for EMS communications the following application forms will be needed:

FCC 400 - Application for Radio Station Authorization (except for Iowa counties listed under FCC Form 425).

FCC 410 - Instructions for completion of FCC 400

FCC 425 - Application for Radio Station Authorization in the following Iowa counties:

Cedar, Clinton, Dubuque, Jackson, Jones, Muscatine, Scott

Use FCC 410 Instructions with FCC 425

FAA 7460-1 Notice of proposed construction or alternation of an antenna

FCC 405A Renewal of Radio License

Appendix B contains excerpts from Subpart B and C of Section 17 of the FCC Rules and Regulations which may be used to determine if FAA 7460-1 must be filed.

Data needed to complete FCC Form 400 includes the following items:

1. Operating frequency
2. Number of base (fixed) transmitters
3. Number of mobile units which will be operating in the EMS region
4. Type of emission (20F3)
5. Transmitter power input (200 watts for Comm Center and 100 watts for Regional Hospital)
6. Name and address of hospital in whose name the license is to be issued or the Iowa Hospital Association for Comm Center licenses.

7. Location of the transmitter(s)
   (a) City
   (b) County
   (c) State
   (d) Latitude
   (e) Longitude
8. Statement of eligibility (Item 15)

FOR COMM CENTERS

"This station will provide coordinated communications within the Iowa EMS region (list number) consisting of , , , , counties. The radio will be used only for the transmission of messages necessary for providing efficient medical services."

FOR HOSPITALS

"Applicant is an institution offering services, facilities and beds for use beyond 24 hours is rendering medical treatment. Radio will be used only for the transmission of messages necessary for providing efficient hospital service."

9. Name of Radio Service: "Special Emergency"
10. Class of Station: Base and Mobile
11. Area of operation of mobile units
12. Location of transmitter control points
13. Overall height above ground of tip of antenna
14. Overall height above ground of antenna supporting structure
15. Point of communication: Base-to-mobile

In filling out these several application forms, use originality and specifically state the purpose for which the equipment will be used and the area of coverage required. A competent communications consultant may be of aid in completing the applications. No filing fee is required for license applications from hospitals, non-profit ambulance/rescue organizations and governmental agencies.

3.6 OPERATOR TRAINING AND PROCEDURES

DISPATCHER RESPONSIBILITIES, TRAINING, AND OPERATIONS

DISPATCHER RESPONSIBILITIES:

The primary responsibility of the Comm Center Dispatcher is to receive incoming EMS requests and dispatch the most appropriate service (most frequently, an ambulance) to the scene of the emergency. "Appropriate" service is defined as the one closest, if available, and one specially equipped to serve an emergency of a certain type, i.e., coronary arrest. A list of dispatcher functions and activities follows:

Dispatcher Functions:

- Receive request for service
- Determine ambulance service most able and available
- Dispatch ambulance via ambulance operations and page EMTS's (optional)
- Notify Law Enforcement or Public Safety
- Notify hospital
- Participate in triage or setup a link between EMT's and hospital Emergency Room
- Request assistance if needed
- Notify hospital of ambulance estimated arrival time
- Connect direct link between ambulance and hospital ER via Comm Center links or hand off radio communications between ambulance and hospital when that link exists
- Monitor the events leading to patient delivery and assist wherever possible
- Maintain ambulance and hospital facility files, location directory, and other action files.
- Exercise command and control authority over the regional EMSCS

A secondary responsibility of the dispatcher is to keep his communication system fully operational. Any loss of service capacity or degradation of

the Comm Center links must be detected and corrected quickly. Backup or alternate routing procedures need to be developed and used when catastrophic failure strikes a normal system.

The dispatcher needs to maintain current information on all regional medical facilities, ambulance vehicle availability, road conditions, and any other data pertinent to providing efficient direction to EMS personnel. He must provide adequate record logs for legal proceedings and performance evaluation.

TRAINING AND QUALIFICATIONS FOR DISPATCHER AND AMBULANCE RADIO OPERATORS

The selection and training of qualified personnel for the Comm Center dispatcher function is important in the ultimate success of the EMSCS operations. The selection of qualified personnel to enter training needs assurance that such personnel have stable personalities, clear and well enunicated speech, familiarity with medical and public safety terminology, (or at least, the capability to learn it quickly), and a modest technical knowledge or experience in the operation of relatively complex communications equipment.

Having selected a suitable group of personnel for training, a formal classroom instruction session should be provided which includes the following subjects:

1. Responsibilities of EMSCS Dispatcher
2. Telephone skills
3. Radio telephone voice techniques for base and mobile stations
4. Law Enforcement (Public Safety) and Civil Defense communications interface techniques and procedures
5. Equipment demonstration and practice in using mockup of or an operational EMS communication system
6. Provide testing and certificate of accomplishment for those who are successful in meeting requirements of the course.

The foregoing concise outline is based on recommendations published by DOT, November 1972 and covers both the base station and ambulance radio operator's

training (Reference 6). The course should be augmented to include special information tailored to the Iowa EMS regional concepts and plans. After initial development and trial usage the course and materials should be certified for instructional usage by the Iowa Vocational Schools.

Following the formal classroom activity, a period of "on-the-job" training in an operational Comm Center with a trained operator is recommended. This would reinforce the classroom experience and provide a smoother transition to the actual operation where people's lives are dependent on quick response and a minimum of operator errors.

Periodic disaster drills and exercises should be planned and conducted to maintain the Comm Center dispatcher's operating expertise in a qualified condition. His day-to-day, normal EMS request handling activity will keep his skills current for routine operation, but functioning under the stress and confusion of the disaster mode requires a disciplined and knowledgeable operator. Each drill will point up deficiencies and the critique will help resolve problems which can minimize errors in an actual disaster operation. Based upon performance ratings, additional training sessions should be available for skill development.

OPERATIONS MANUAL:

The EMSCS "Operations Manual" will provide a means of unifying EMS communications procedures within the State of Iowa. A manual is recommended similar to the DOT-EMS Operators Manual (Reference 6) or the Mississippi Hospital Association Manual (Reference 7). These manuals detail the equipment operation, emergency operating procedures, day-to-day operating procedures, and provide a directory of codes and of services. The distribution of the manual should be controlled so that changes can be routed to all manual holders as they occur.

It is recommended that preparation and distribution of this manual be the responsibility of the Communications Division, State of Iowa.

PROCEDURAL SIGNALS

A procedural code using 10-signals has been developed and adopted by the Associated Public Safety Communications Officers Inc. (APCO) and is universally used for nationwide public safety radio operations. The official APCO 10-signal list of 1 March 1969 is shown in Table 3-4 with an asterisk to designate those codes having a specific EMS significance.

It is recommended that these be used by Comm Center operators and ambulance attendants in radio procedures. This will enhance message brevity and conciseness and consequently message traffic can be handled more rapidly. The 10-signals also will provide a common communications language for inter-district and inter-state patient transfer and reduce intelligibility difficulties.

Many of the APCO 10-signals are specifically referenced to law enforcement and public safety but there are not sufficient medical terms in the listing for medical communications. As a consequence it is recommended that a standard set of medical signals be adopted by the EMS Advisory Committee for statewide use in Iowa.

A suggested set of medical 2-signals developed and now in use by the Area Ambulance Service stationed at Mercy Hospital in Cedar Rapids are shown in Table 3-5. Those signals listed beyond 2-26 have been added to the list for purposes of this report to include certain procedures not previously designated. This signal list is open-ended for additional growth and could become standardized for nationwide use after a period of development. It is recommended that no attempt should be made to merge the 2-signals with the 10-signals as only dangerous confusion will result. However, they should be used together since they are mutually complimentary.

Effort by the Department of Transportation Highway Safety Program Communications Section is continuing to develop a broad medical signal listing and operating procedure capable of direct keyboard input to a medical data file processing system. It is recommended that this activity be followed closely during the EMSCS development period.

TABLE 3-4 APCO 10-SIGNAL LIST

10-0	Caution	*10-20	Location
*10-1	Unable copy - change location	*10-21	Call ..... by telephone
10-2	Signal good	10-22	Disregard
10-3	Stop transmitting	*10-23	Arrived at scene
*10-4	Acknowledgment (OK)	*10-24	Assignment Completed
10-5	Relay	10-25	Report in person (meet)
*10-6	Busy - unless urgent	10-26	Detaining subject, expedite
*10-7	Out of service	10-27	(Drivers) license information
*10-8	In service	10-28	Vehicle registration information
*10-9	Repeat	10-29	Check for wanted
10-10	Fight in progress	*10-30	Unnecessary use of radio
10-11	Dog case	10-31	Crime in progress
*10-12	Stand by (stop)	10-32	Man with gun
*10-13	Weather - road report	*10-33	EMERGENCY
10-14	Prowler report	10-34	Riot
10-15	Civil disturbance	10-35	Major crime alert
10-16	Domestic problem	*10-36	Correct time
10-17	Meet complainant	10-37	(investigate) suspicious vehicle
*10-18	Quickly	10-38	Stopping suspicious vehicle
*10-19	Return to	*10-39	Urgent - use light, siren

* Denotes applicability to Ambulance Communication

TABLE 3-4 (Continued) APCO 10-SIGNAL LIST

*10-40	Silent run - no light, siren	10-60	Squad in vicinity
10-41	Beginning tour of duty	10-61	Personnel in area
10-42	Ending tour of duty	10-62	Reply to message
*10-43	Information	10-63	Prepare make written copy
10-44	Permission to leave....for..	10-64	Message for local delivery
10-45	Animal carcass at	10-65	Net message assignment
10-46	Assist motorist	10-66	Message cancellation
10-47	Emergency road repair at ..	10-67	Clear for net message
10-48	Traffic standard repair at ..	10-68	Dispatch information
10-49	Traffic light out at ..	10-69	Message received
*10-50	Accident (F, Pl, PD)	10-70	Fire alarm
*10-51	Wrecker needed	10-71	Advise nature of fire
*10-52	Ambulance needed	10-72	Report progress on fire
10-53	Road blocked at ...	10-73	Smoke report
10-54	Livestock on highway	10-74	Negative
10-55	Intoxicated driver	10-75	In contact with
10-56	Intoxicated pedestrian	*10-76	En route
*10-57	Hit and run (F, Pl, PD)	*10-77	ETA (Estimated Time Arrival)
10-58	Direct traffic	*10-78	Need assistance
*10-59	Convoy or escort	*10-79	Notify coroner

10-80 through 10-99 are not applicable to medical communications

* Denotes applicability to Ambulance Communication

TABLE 3-5 PROPOSED 2-SIGNAL LIST FOR EMSCS

	EMS 2-SIGNAL
2-09	ALCOHOL INTOXICATION
2-10A	POSSIBLE DOA
2-10B	PROBABLE DOA
2-11	CARDIAC
2-12	HEAD INJURY
2-13	UNCONSCIOUS
2-14	SEIZURE
2-15	PREGNANCY
2-16	SEVERE HEMORRHAGE
2-17	POSSIBLE INTERNAL INJURY
2-18	DIABETIC SHOCK
2-19	MENTAL CASE
2-20	POISON OVERDOSE
2-21	SEVERE BURN
2-22	CVA (CARDIO-VASCULAR ACCIDENT)
2-23	FRACTURE
2-24	MEDICAL PROBLEM UNKNOWN
2-25	INVALID TRANSFER
2-26	DIRECT ADMIT
2-27	PHYSICIAN REQUIRED (AMBL.)
2-28	PHYSICIAN ON DUTY (EMERGENCY ROOM)
2-29	VITAL SIGN TRANSMISSION (AMBL.)
2-30	VITAL SIGN TRANSMISSION CLEARED (EMERGENCY ROOM)
2-31	END VITAL SIGN TRANSMISSION (AMBL.)
2-32	PHYSICIAN DIAGNOSIS TRANSMISSION (EMERGENCY ROOM)

3.7 SPECIAL SYSTEMS

STATE UNIVERSITY HOSPITAL - IOWA CITY

The facilities of the State University Hospitals and its medical schools are a special resource for emergency medical services in the State of Iowa. This requires a special communications system consideration beyond that of the specific regional Comm Center.

Many emergency and long term patients with special medical requirements are transferred daily into Iowa City. The communications facility, therefore, should be able to communicate with ambulance vehicles using Channel A as they approach the Iowa City vicinity. This special Comm Center should be more closely linked with other regional Comm Centers in the state so that communications can be established quickly between the emergency personnel in other EMS regions and appropriate personnel in the University Hospital facilities. This will require a special Comm Center having a larger number of incoming common carrier lines than the average Comm Center. A greater weighting should be given to the implementation and use of the Channel B radio point-to-point operations for other than Civil Defense activities. A radio linkage is feasible from Iowa City to the Cedar Rapids, Ottumwa, Davenport, Burlington, Marshalltown and Waterloo Comm Centers. This provides a major disaster redundancy for common carrier communications channels over the entire eastern half of Iowa and provides ability to reach an unaffected Comm Center which can patch into a usable common carrier trunk.

The establishment of common carrier GSA Telpak usage between EMSCS Comm Centers in the state is worthy of planning effort due to the special requirements of the University Hospitals Comm Center.

The Comm Center at University Hospitals could also serve Johnson and Washington County ambulance operations as a normal Comm Center since it can cover these two counties more completely than the regional Comm Center in Cedar Rapids. Local considerations may dictate that the special Comm Center in Iowa City should be operated by the Johnson County sheriff's office in close cooperation with the University Hospitals.

COUNCIL BLUFFS

The Health Planning Council of the Mid-lands includes several Nebraska counties. Omaha, Nebraska has a 911 system presently serving in an emergency communication request role which is a model for the Midwest. (Reference 9, page 24).

These special features can be augmented readily by providing a Comm Center in this area which cooperatively provides linkages between the Omaha 911 and the Iowa EMSCS which can provide radio ambulance service to a range of approximately thirty five (35) miles into Nebraska if desired.

It is recommended that the Midlands Health Council consider this cooperative linkage between Nebraska and Iowa and develop a maximum area EMSCS. Note: The Comm Center could be located in either state. Hospital radio facilities could be shared in a similar fashion between these of Omaha and Council Bluffs.

3.8 CENTRAL COMPUTER USAGE

The EMSCS program operations in the future would benefit greatly through a development to utilize a central state data system for file and retrieval of emergency medical services inventories and records. This could be achieved from the utilization of an expanded TRACIS data system. The TRACIS network is attractive since it is available to many local law enforcement agencies and to all Iowa Police Radio base stations. Because of the recommendation that the EMSCS be planned and implemented through state agencies, it is relatively easy for the system to have access to the computer terminal network.

The implementation of a data filing and retrieval system should be planned to have the following minimum capabilities:

- Keyboard entry of ambulance service requests (logging) and the disposition of these requests. This information would aid in the development of traffic records for public safety and would save

manual logging and record keeping at each region. It would allow centralized report preparation and summarization and could allow each region to call for a summary of its records periodically for review and analysis.

- Keyboard entry of trauma victim condition and case data. This would operate somewhat in the manner that is being developed for the Illinois Trauma Registry and would be an optional feature that could assist in a medical records study, and to provide a visibility of the EMSCS functional performance.

- A computer file and retrieval system to allow for the updating of volatile inventory information. The dispatch operator in the Comm Center must maintain a hospital/ambulance facility and capability inventory which should also include a key personnel inventory and contact information for these key personnel. Much of this information could be kept in a periodically updated directory, however, there is a fairly large turn-over of facility and personnel requiring an update addendum to any periodically published directory. The computer therefore would provide a marked assistance in the publication of these directory volumes.

- Access to a vehicle accident or trauma scene location system. A computer terminal and access to it from the dispatch location at the Comm Center could provide current conditions summaries for updating the routing files. The volatile data for changing the file could be provided through the Highway Commission or through various public safety reporting sources.

It is recommended that the Department of Health work cooperatively with the Departments of General Services, Public Safety and other State agencies to develop a central computer usage capability for emergency medical services.

4.0 IMPLEMENTATION AND COST SUMMARY

GENERAL APPROACH

The Communications Plan, Section 3, has detailed the design of a statewide EMSCS via generic subsystem groups of equipments for Comm Centers, hospitals, ambulance/rescue vehicles and law enforcement/public safety agencies. Recommendations are developed for the county composition of regions, for the Comm Center location, and for the remote base station locations in each region. Information was derived in the survey on which to base recommendations for hospital EMS radio system installations needed to mitigate message traffic loads which will develop in the highly populated regions. These factors provide a solid base upon which to develop the EMSCS implementation plans and the required budgets for a phased construction of Comm Centers and the communication links into public and private hospitals and to the ambulance service operations. This section develops these plans for a five (5) year time-phased installation period. Iowa needs the EMSCS and should attempt implementation in less than five (5) years, if possible.

The rationale for regional priorities assumed herein is based on a joint weighting of message traffic load (needs), current regional planning efforts, and an estimation of the financial flow required per year to accomplish these tasks.

It is recommended that the EMSCS implementation be assured through joint agency budgeting for Comm Center, ambulance and hospital installations. Federal funds should be available from the Department of Transportation, Highway Safety Act, the Law Enforcement Administration Agency, the Civil Defense Agency, and various agencies of Health Education and Welfare. Preparation of proposals to obtain support of these agencies is the responsibility of the Iowa Department of Health, General Services, Public Safety, with cooperation of the Office for Planning and Programming and the EMS Advisory Councils. Obtaining matching funds from public and private agencies should be sought through regional health planning councils and hospital and ambulance associations. Multiple purchases should be considered for Comm Center, hospital and ambulance equipments to reduce costs.

IMPLEMENTATION CRITERIA AND REGIONAL SELECTION

In order to establish implementation plans and cost estimates, it is necessary to determine a regional Comm Center implementation priority and to determine which regions should have EMS radio base stations at hospitals in addition to the regional Comm Center stations. The following criteria were used in the determination of those regions where hospitals should have radios:

1. Regions in which the estimated initial peak message traffic loading through the Comm Center, if no hospital base stations were utilized, is greater than twenty (20) messages per hour.
   Note: This is a different criterion than in Section 3.2.10 and is used to allow both for errors (omission) in data on which present message load is based and the growth of message traffic expected to occur shortly after the EMSCS becomes operational.
2. More than one major medical facility is located in the region.
3. Two or more hospitals are located in a city even though they are jointly served by a Comm Center.

Using these criteria, Cost Tables 4-1 and Table 4-2 were developed. This shows the specific cities in which hospitals already have or should have radio base stations. An accurate estimate for the cost of bringing these installations to EMSCS standards is difficult to develop because several hospitals have some radio equipment. To assure a common base for estimation of maximum costs, a standard cost for these installations based on all new equipment purchase is $4,550 per hospital (1972 list prices). This cost is detailed in Appendix C under Type F and Type H.

The estimated cost of the electronic/electrical equipment, construction and site costs for the Comm Center and associated remote base stations in each of the regions is given in Table 4-2. The total estimated cost for these stations based on 1972 list prices is $583,748. The development of these costs is detailed in Appendix C. The estimated cost of each of the regional Comm Center and Remote Base Station installations listed in Table 4-2 includes a chain-link security fence which encloses a 20 feet by 20 feet area at the base of the antenna tower and includes an

TABLE 4-1 REGIONAL HOSPITAL BASE STATION SELECTION

Region	Comm Center Location	Regional Message Traffic Loading (Peak Messages/hour)	Hospitals Which Should/Do Have Radios	Approximate number of ambulances in Region (Jan 1973)
1	Decorah	< 20		17
2	Mason City	26	Mason City - Mercy Charles City *	29
3	Spencer	< 20	Spencer *	13
4	Sheldon	< 20		13
5	Sioux City	> 20	Sioux City * Onawa *	26
6	Storm Lake	< 20		23
7	Fort Dodge	< 20	Fort Dodge - Bethesda * Fort Dodge - Mercy *	18
8	Waterloo	32	Waterloo	37
9	Dubuque	> 20	Dubuque - Mercy *	16
10	Davenport	21	Davenport - Mercy *	21
11	Cedar Rapids Iowa City	63	C.R. - Mercy/St. Lukes * University Hospitals	33
12	Marshalltown	< 20		19

* Currently has 155 MHz SERS Radio Equipment but it is not known if the equipment meets EMSCS specifications.

TABLE 4-1 (Continued)

Region	Comm Center Location	Regional Message Traffic Loading (Peak Messages/hour)	Hospitals Which Should/Do Have Radios	Approximate number of ambulances in Region(Jan1973)
13	Des Moines	56	Des Moines (Several) Boone *	60
14	Atlantic	<20		18
15	Carroll	<20		13
16	Council Bluffs	23	Council Bluffs - Harlan *	40
17	Creston	<20		16
18	Chariton	<20		14
19	Ottumwa	<20		21
20	Burlington	28	Burlington Memorial *	17
			TOTAL	464

* Currently has 155 MHz SERS Radio Equipment but it is not known if the equipment meets EMSCS specifications.

TABLE 4-2 REGIONAL EMSCS IMPLEMENTATION ESTIMATED COST SUMMARY (1972 PRICES)

Region	Comm Center Location	RemoteBase Location	Cost** Type Number	Electrical Equipment Costs	Construction Costs *	Total Regional Installation Costs	Weighted Priority for Regional Implementation
1	Decorah		D	$ 6,650	$ 8,399		13
		Decorah	B	5,600	8,399		
		Elkader	B	5,600	5,117		
				$17,850	$21,915	$39,765	
2	Mason City		G	$ 9,700	$17,309		8
		Woden	B	5,600	5,117		
				$15,300	$22,426	$37,726	
3	Spencer		A	$ 5,100			12
		North of Ruthven	B	5,600	$ 5,117		
				$10,900	$ 5,117	$15,817	
4	Sheldon		A	$ 5,100			2
		Boyden	B	5,600	$17,309		
				$10,700	$17,309	$28,009	
5	Sioux City		E	$11,700	$ 5,117		2
		Onawa	B	5,600	5,259		
		Washta	B	5,600	5,117		
				$22,900	$15,493	$38,393	
6	Storm Lake		A	$ 5,100			17
		Varina	B	5,600	$ 5,117		
				$10,700	$ 5,117	$15,817	

* Includes $1,000 for installation of a 20 ft. by 20 ft. security fence surrounding the tower base and equipment enclosure.

** See Appendix C for detailed cost estimates.

TABLE 4-2 REGIONAL EMSCS IMPLEMENTATION ESTIMATED COST SUMMARY (1972 PRICES)

Region	Comm Center Location	RemoteBase Location	Cost ** Type Number	Electrical Equipment Costs	Construction Costs *	Total Regional Installation Costs	Weighted Priority for Regional Implementation
7	Fort Dodge		A	$ 5,100	$		11
		Vincent	B	5,600	$ 5,117		
				$10,700	$ 5,117	$15,817	
8	Waterloo		A	$ 5,100			5
		Denver	B	5,600	$22,437		
				$10,700	$22,437	$33,137	
9	Dubuque		A	$ 5,100			9
		Asbury	B	5,600	$18,009		
				$10,700	$18,009	$28,709	
10	Davenport		C	$ 8,450	$18,009	$26,459	6
11	Cedar Rapids		C	$ 8,450	$18,009		1
	Iowa City (Special) See Section 3.7		C	8,450	9,329		
				$16,900	$27,338	$44,238	
12	Marshalltown		C	$ 8,450	$22,897	$31,347	10
13	Des Moines		A	$ 5,100			3
		Bondurant	B	5,600	$22,897		
				$10,700	$22,897	$33,597	

* Includes $1,000 for installation of a 20 ft. by 20 ft. security fence surrounding the tower base and equipment enclosure.

** See Appendix C for detailed cost estimates.

TABLE 4-2 REGIONAL EMSCS IMPLEMENTATION ESTIMATED COST SUMMARY (1972 PRICES)

Region	Comm Center Location	RemoteBase Location	Cost** Type Number	Electrical Equipment Costs	Construction Costs *	Total Regional Installation Costs	Weighted Priority for Regional Implementation
14	Atlantic		A	$ 5,100			14
		Adair	B	5,600	$ 9,329		
				$10,700	$ 9,329	$20,029	
15	Carroll		C	$ 8,450	$18,009	$26,459	14
16	Council Bluffs		D	$ 6,650	$14,613		4
		Portsmouth	B	5,600	5,117		
		Imogene	B	5,600	5,117		
				$17,850	$28,847	$46,697	
17	Creston		A	$ 5,100			15
		Shannon City	B	5,600	$ 9,329		
				$10,700	$ 9,329	$20,029	
18	Chariton		C	$ 8,450	$22,287	$30,737	16
19	Ottumwa		C	$ 8,450	$22,287	$30,737	16
20	Burlington		A	$ 5,100			7
		West Burlington	B	5,600	$ 9,329		
				$10,700	$ 9,329	$20,029	
						$583,748	

* Includes $1,000 for installation of a 20 ft. by 20 ft. security fence surrounding the tower base and equipment enclosure.

** See Appendix C for detailed cost estimates.

equipment enclosure. Some regions may consider this degree of protection inadequate and may wish to include a larger area at the base of the tower to enclose the antenna guy anchors. In that event, the installed cost of the fencing may be estimated at $10 per running foot.

The weighted priority discussed above for implementation of EMSCS is also listed in Table 4-2. Using this weighted priority, a five (5) year implementation program results in the yearly expenditure shown in Table 4-3. These expenditures are based on 1972 list prices and have been adjusted for a five (5) percent annual inflation rate. This table also includes the cost of adding the specified radio equipment to the estimated four hundred sixty four (464) ambulance vehicles in Iowa and is based on a $2,300 per ambulance (1972 list price) adjusted for a five percent (5%) annual inflation factor over the 1974 through 1978 proposed implementation period.

The estimated cost of several items of specific EMSCS effort are detailed below. Table 4-3 includes the estimated maximum cost of the system engineering for specific facilities for each year's implementation.

SPECIFIC EMSCS EFFORT REQUIRED DURING PHASED IMPLEMENTATION

The EMSCS presented in this report is generically complete. However, several additional items of effort are necessary to assure specific problem solutions in each region's implementation and in the operation of several unresolved elements of the system. These include:

- Preparation of a communications procedures (dispatcher's) manual
- Preparation of a dispatcher training materials
- Detailed signal coverage analysis for specific installations
- System engineering for specific facilities

The first two items could be prepared by an advisory committee, however, the two final items must be prepared by competent communications system engineers.

TABLE 4-3 ESTIMATED ANNUAL EXPENDITURES FOR TOTAL REGIONAL EMSCS IMPLEMENTATION COSTS *

Fiscal Year	Regions Implemented	Comm Center Remote Base Equipment Construction	Ambulance Radio Equipment	Hospital Base ** Station Equipment	System Engineering	Total Implementation
1974	4, 5, 11, 13	$ 151,449	$ 334,719	$ 20,506	$ 24,255	$ 530,929
1975	8, 10, 16, 20	139,270	306,192	31,545	25,468	502,475
1976	2, 7, 9, 12	131,505	229,244	16,531	26,741	404,021
1977	1, 3, 14, 15	124,309	179,062		28,078	331,449
1978	6, 17, 18, 19	124,210	228,084		29,482	381,776
		$ 670,743	$1,277,301	$ 68,582	$ 134,024	$2,150,650

* Based on 1972 list prices adjusted for an annual inflation rate of 5%.

** Does not take into account any existing 155 MHz equipment since it is not known if the equipment meets EMSCS specifications.

The detailed scope and an estimated cost to produce the items for these additional efforts is as follows:

Preparation of training materials:

- Personnel dispatcher application form
- Dispatcher job description
- Development of dispatcher course materials (10 hour course)
- Teaching aids
- Specific training of a class of ten (10) students for ten (10) class hours
- Training an instructor who would provide continuing instruction
- Estimated total $ 9,000

Note: It is expected that an operational EMSCS terminal could be used for instruction.

Preparation of EMSCS Procedures Manual:

- Develop operational procedures for the EMSCS Comm Center, hospital terminals, ambulance and law enforcement/local government terminals
- Print and bind manual (loose leaf binder)
- Provide one hundred (100) copies
- Estimated Total $ 7,500

System Engineering for specific facilities in each region:

- Provide detailed radio signal coverage analysis for each facility in the region when the exact geographical location for the antenna has been selected.
- Determine the required antenna height, antenna gain and its directivity for the Comm Center local base, remote base stations and hospital base station locations.
- Provide a layout plan equipment installation for the Comm Center including location of console, terminal equipment placement, remote control wiring design.
- Prepare purchase orders for equipment and assist in bid review.
- Perform expediting of equipment and services including telephone equipment.

- Supply assistance for FCC license applications and for development of a filing system for ambulance/rescue unit availability, hospital facilities availability, emergency vehicle routing and other specific regional data.
- Conduct tests of system performance after completion of installation and assist in selection and training of personnel.
- Estimated Total per Region $ 5,500

The cost of this effort may be reduced significantly if the work is performed in one scope for a group of four or more regions. It is recommended that an estimate be obtained for those items of scope for which assistance is needed at the start of specific regional (or regional groupings) systems planning.

5.0 RECOMMENDATIONS

There are several categories of recommendations made in this report. These are collected and grouped for ease in recognition of responsibilities.

Several other recommendations may be recognized in the plan, however, these were believed to be less urgent to display although they should not be considered unimportant or negligible.

A. ORGANIZATIONAL RECOMMENDATIONS

1a. It is recommended that the responsibility for developing the EMSCS Comm Center implementation, operation and maintenance be vested in the Department of Health, Community Health Services.

1b. It is recommended that the technical planning responsibility for the EMSCS be that of the Department of General Services, Communications Division.

2. It is recommended that the EMSCS disaster and major emergency operational modes be considered in the emergency preparedness plans of the Iowa Civil Defense especially as related to point-to-point radio communications.

3. It is recommended that the selection of the specific organizations which operate the Comm Centers be accomplished through mutual concurrance of those agencies having responsibility for statewide communications, medical services and public safety.

4. It is recommended that those responsible for the EMSCS organize and engage in interstate EMS communications conferences to develop joint system plans to enable a maximum of commonality of standard procedures and to avoid radio channel interference of harmful proportions.

5. It is recommended that the Office of the Communications Division develop and periodically issue an EMSCS directory.

6. It is recommended that all FCC licenses for regional Comm Centers be handled by the Iowa Hospital Association with coordination provided by an augmented APCO Frequency Coordinating Committee.

7. It is recommended that the Office of Communications Division work cooperatively with other agencies to develop a central computer usage capability for emergency medical services.
8. It is recommended that pending ambulance license legislation require that all ambulances/rescue units operating in Iowa be equipped with two-way radio equipments meeting the EMSCS requirements by 1978.

B. OPERATIONAL AND PROCEDURAL RECOMMENDATIONS

1. It is recommended that the EMSCS Directory list the various in-service digital dial codes by city, county, region and EMS service function in alphabetical order. Also, provide a list of the specific tones used in tone coded squelch by the various medical facilities and Comm Centers. This directory will contain listings of the medical 2-codes and the Public Safety APCO 10-codes discussed in Section 3.2.6. Also, the directory will list all participating ambulances by a four (4) digit numeric designator.
2. It is recommended that the 10-signal and 2-signal procedures be used by Comm Center operators and ambulance attendants for operations. No attempt should be made to merge the 2-signal with the 10-signal as only dangerous confusion will result.
3. It is recommended that training programs and dispatching procedures be established prior to the commencement of EMSCS operations. A formal operator's manual should be developed similar to the DOT/EMS operator manual, Reference 6, or the Mississippi Association Manual used for their EMS (Reference 7). Responsibility for development and approval of these programs shall be vested with the Communications Division, State of Iowa.
4. It is recommended that the Comm Center Operational Procedures Manual contain the requirement that the quantity of unused tape in the cassette is to be checked and recorded in the log at the beginning of each shift and at the end of the emergency request or post record section.
5. It is recommended that the length of time required for EMS record retention be included in any pending EMS relating legislation.

6. It is recommended that a system for EMS requests be developed through the statewide telephone system on a region-to-region basis in the manner described in Section 3.2.6. Responsibility for negotiation of these arrangements shall be accorded the Communications Division, State of Iowa. Specific regional implementation problems involving the telephone company should first be taken to the Communications Division, State of Iowa.

C. DESIGN STANDARDIZATION RECOMMENDATIONS

1. It is recommended that the following EIA, Group B tone coded squelch frequencies be used on a regional channel (R-Channel) when such operations is approved by the EMS Advisory Committee. These are 82.5, 94.8, 110.9, 127.3, 146.2, 167.9, 192.8, and 225.7 Hz.
2. It is recommended that upon selection of an available site for base stations and prior to procurement of site, a complete analysis of the communications from that site be performed to assure reliability of communications and to avoid undue interference.

D. EQUIPMENT RECOMMENDATIONS

1. It is recommended that a metropolitan hospital radio operational system be implemented (Section 3.3.2) for Des Moines, Cedar Rapids, Waterloo/Cedar Falls, Sioux City, Council Bluffs, Burlington, and Davenport as the EMSCS is initiated.

2. It is recommended that GSA Telpak or common carrier facilities be considered for linking the Comm Centers in the development and expansion of those services.
3. It is recommended that each Comm Center have at least two (2) incoming emergency request telephone lines on a rotary sequence in order to handle incoming EMS requests, if the first line were

busy. The criterion for performance shall require that all calls for emergency service be answered in fifteen (15) seconds.

4. It is recommended that a tape recorder be employed in all Comm Centers for insuring that dispatch information is received correctly.

E. FCC, FREQUENCY COORDINATION AND IOWA TARRIFF NO. 1 RECOMMENDATIONS

1. In order to promote the orderly assignment of Special Emergency Radio Service (SERS) frequencies, it is recommended that the Iowa SERS frequency coordination be established under cognizance of the Associated Public Safety Communications Officers (APCO).

2. (a) It is recommended that 155.235 MHz be used statewide for hospital-to-hospital Comm Center-to-Comm Center and for Comm Center-to-hospital point-to-point emergency communications.

(b) It is recommended that the use of 155.235 MHz point-to-point radio channel be implemented only when its function has been included in Civil Defense area plan regional disaster operations.

3. Providing there is no favorable resolution of the FCC Docket 19643 to allow EMS personnel paging on the 157.450 MHz channel, it is recommended that the SERS 155.295 MHz (Channel P) be utilized for statewide paging of medical and ambulance technician personnel by hospital and ambulance EMS radio systems. Radio systems thus used will not have more than a ten (10)-mile operational service radius in voice paging services.

4. (a) It is recommended that the SERS 155.340 MHz frequency be used statewide for all communications between ambulances and Comm Center, ambulances and hospitals, and between ambulances.

(b) It is recommended that the SERS frequencies of 155.325 MHz, 155.355 MHz, 155.385 MHz, and 155.400 MHz be assigned for use in a regional 4-frequency plan when traffic loading or a special operation is required in the EMSCS.

5. It is recommended that no ambulance service, either public or private be allowed to operate a base station on the assigned statewide or regional EMS frequencies unless that service is the Comm Center for that region.

6. It is recommended that the radio paging of EMS personnel (emergency) take place on the statewide base-to-mobile frequency (Channel A). Such activity should be limited to paging EMTA's, other ambulance/rescue unit emergency personnel, and to hospital cardiac arrest teams by the Comm Center dispatcher only.

7. It is recommended that administrative paging or radio communications to other medical and hospital personnel from the Comm Center or its remote base stations be conducted on a frequency channel other than those assigned in the VHF high-band SERS grouping.

8. It is recommended that the use of the four (4) separate SERS low-band VHF frequencies be coordinated by APCO (See Section 3.2.7) and that assignment of those frequencies for one-way paging be in accordance with the four-frequency regional assignment plan shown on the map of Figure 3-7.

9. It is recommended that the development of medical data telemetry (MDT) usage be followed closely to anticipate the need and provide the recommended way to incorporate in the EMSCS. It is also recommended that close contact be maintained with largely rural states as they become aware of their needs in MDT when they begin to plan and implement EMSCS.

10. It is recommended that the Iowa Tariff No. 1, Telephone Exchange Service, be amended in Part IV Section 3, 3rd Revised Page 12: To revoke the regulation requiring a recorder tone device (beeper) when recording from telephone lines used in public safety and emergency medical services. This gains an improved message intelligibility and reduces the operating cost.

11. It is recommended that there be a working arrangement developed between the Telco and State Communications Division to add a provision for telephone operators answering dial "O" for emergency calls and making an immediate transfer to the nearest EMSCS Comm Center. This pro-

vision shall require the telephone company to print appropriate instructions in all its directories regarding the use of this emergency service.

F. PROGRAM IMPLEMENTATION RECOMMENDATIONS

1. It is recommended that the EMSCS implementation be assured through joint agency budgeting for Comm Center, ambulance and hospital installations. Federal funds should be available from the Department of Transportation, Highway Safety Act, the Law Enforcement Administration Agency, the Civil Defense Agency and various agencies of Health Education and Welfare. Preparation of proposals to obtain support of these agencies is the responsibility of the Iowa Department of Health, General Services, Public Safety, with cooperation of the Office for Planning and Programming and the EMS Advisory Council. Obtaining matching funds from public and private agencies should be sought through regional health planning councils and hospital and ambulance associations.

2. It is recommended that the Department of Health work cooperatively with the Departments of General Services, Public Safety and other State agencies to develop a central computer usage capability for emergency medical services.

6.0 REFERENCES

1. "An Area Wide Plan for Emergency Medical Services", Siouxland Health Planning Council, July 1972.
2. McQueen, John C; Eldridge, Eber; "A Proposed Organizational Structure for Providing Health Services and Medical Care in the State of Iowa", Health Manpower Committee of the Iowa Comprehensive Health Planning Council, August, 1972.
3. Longely, A.G.; Rice, P.L.; "Prediction of Tropospheric Radio Transmission Loss Over Irregular Terrain, A Computer Method", 1968 ESSA Technical Report ERL-79-ITS 67.
4. Emergency Medical Services Communications Study, First Interim Report, Spectra Associates, Inc., 12 July 1972
5. Emergency Medical Services Communications Study, Second Interim Report, Spectra Associates, Inc., 16 October 1972
6. Dispatcher, Emergency Medical Technician Training Course, U.S. Department of Transportation, NHTSA, 1972 (DOT/HS-810-224)
7. "Emergency Operations Manual", Communications Network of the Mississippi Hospital Association, Jackson, Mississippi 1968
8. "EIA Standard RS-220", April 1959 Electronics Industries Association, 11 West 42nd Street, New York, N.Y.
9. "911 Conference", Journal of Public Communications, December 1972, The Associated Public Safety Communication Officers, Inc., P.O. Box 669, New Smyrna Beach, Florida, 32069
10. Federal Register, Volume 37, No. 232, page 25546, 1 December 1972
11. "Communications, Guidelines for Emergency Medical Services, U.S. Department of Transportation, NHTSA 1972 (DOT/HS-820214)
12. Emergency Medical Services Communications Systems, U. S. Department HEW, Division of Emergency Health Services, Publication No. (HSM 73-2003)
13. "Regional Delineation for the State of Iowa", Prepared by the Office for Planningnand Programming, State Capitol, Des Moines, 1967, Revised 20 November 1972.

BIBLIOGRAPHIC REFERENCES

Emergency Medical Services Study - State of Nebraska Department of Health, January 1971, Milton S. Parker, Director

Telecommunications Study Report - State of Nebraska State Telecommunications Study Committee, April 1970. Robert D. McManus, Director (Department of Administrative Services)

Telecommunications for State Government Operations - Special State Study Committee, January 1965 to January 1967, Brig. General D. G. Penterman, Committee Chairman.

Emergency Services Communications - Project No. EM 71-003(001) of the U. S. Department of Transportation, Federal Highway Administration, National Highway Safety Bureau, Prepared by: Mid-America Research Center, 104 Executive Building, 521 S. 14th St., Lincoln, Nebraska 68508. September 1971

The Feasibility of A State-Wide Communications Network - State of Nebraska. Prepared for and at the direction of the Nebraska State Government Consolidated Communications Committee, John B. Heffelfinger, P.E. 9208 Wyoming Place, Kansas City, Missouri, November 1965.

The Radio Communication System - University of Missouri Medical Center, EMS Bulletin No. 3, May 1969. Published in Cooperation with Missouri Division of Traffic Safety and National Highway Safety Bureau, Department of Transportation.

Plan for Emergency Medical Communications in Oregon - State of Oregon, Traffic Safety, Commission, 1970 December.

Revised Accident Rate by County for the State of Iowa - 1968-1970, Prepared by the Department of Public Safety, January 14, 1972

Inventory of Resources of Story County - Prepared for Emergency Operations Simulations, conducted in Nevada, Iowa, March 11 through 20, 1971 by Civil Defense Program, Iowa State University in cooperation with Story County and Municipal Civil Defense Administration, Iowa Department of Public Defense, Civil Defense Division, Department of Defense, Office of Civil Defense.

Federal Contributions for Civil Defense Equipment - Federal Civil Defense Guide, Part F, Chapter 5, Appendix 1 with Annexes 1-5, dated January, 1970, Published by Department of Defense, Office of Civil Defense

Guide for Conducting State and Community Surveys of Ambulance Services and Hospital Emergency Departments, Docmment DEHS-14 Published by U. S. Department of Health, Education and Welfare, January 1972.

Emergency Medical Communications, Wisconsin - 1969, Published by the State of Wisconsin, Division of Health, Bureau of Health Statistics, Section of Statistical Services, Madison, December 1969.

Operators Manual, Emergency - Prepared for by the Communications Network of the Hospital Council of Southern California, possible date of 1971.

General Hospitals in Dane County, - Wisconsin, Selected information and recommendations from the E. D. Rosenfeld report, November 1969, prepared for the Review and Evaluation Committee of the Health Planning Council, Inc. January 1971

Wisconsin Emergency Ambulance Survey - Report B, Description and Analysis of Emergency Ambulance Service by Martin A. Werner, Peter K. Wright, Published by the Division of Health, Wisconsin Department of Health and Social Services, prepared by the Bureau of Health Statistics, dated May 1970.

Hospital Emergency Command System Planning Kit - prepared by Emergency Care Research Institute, 913 Walnut St., Philadelphia, Pennsylvania

A Study of Iowa Ambulance Service - by Lyle L. Shook, Bureau of Police Science, University of Iowa, Iowa City, March 1968.

Hospital Based Ambulance Service, - Compiled and edited by Lyle L. Shook, Richard L. Holcomb.

Population and Land Area of Counties, Table 9 - 1970 and 1960 from the Summary Volume 17-20 Iowa, U. S. Bureau of Census 1970.

National Mobile Telephone Service Area Listings - March 1972, prepared by United States Independent Telephone Association and the American Telephone and Telegraph Company as of December 1971.

Emergency Communications System - Hospital Council of Southern California, November 11, 1970

Sophisticated Radio Network Successful - Reprinted from Hospitals, Journal of the American Hospital Association, Volume 45, December 1, 1970.

Date With Disaster - A model for multi-hospital Preparedness, Office of Emergency Preparedness, Executive Office of the President, Washington, D.C.

Amendments of Parts 89, 91, and 93 of FCC rules to provide for expanded non-voice communication techniques including radioteleprinter, radio-fascimile and ambulance telemetering. Docket No. 19261, Report and Order Adopted March 23, 1972, Released March 29, 1972.

EIA STANDARD, Minimum Standards for Land Mobile Communication FM or PM Transmitters, 25-470 MHz - RS-152-B Engineering Department, Electronic Industries Association, February 1970 # EIA RS-152-B

EIA Standard RS-204, Minimum Standards for Land-Mobile Communication FM or PM Receivers, January 1958, Engineering Department., Electronic Industries Association

Structural Standards for Steel Antenna Towers and Antenna Supporting Structures - EIA STANDARD # RS-222-A, November 1966, Engineering Department., Electronic Industries Association

Minimum Standard for Land-Mobile Communication Systems Using FM or PM in the 25-470 MC Frequency Spectrum - EIA STANDARD # RS-237, August 1960, Engineering Department., Electronic Industries Association

Minimum Standards for Land-Mobile Communication Antennas Part 1, Base or Fixed Station Antennas - EIA STANDARD # RS-329, December 1966, Engineering Department, Electronic Industries Association

Minimum Standards for Portable/Personel Land-Mobile Communications FM or PM Equipment - EIA STANDARD, # RS 316, July 1965, Engineering Department Electronic Industries Association

Land Mobile Selective Signaling Standard - EIA STANDARD # RS-374, June 1970, Engineering Department, Electronic Industries, Association.

VHF Receiving Antenna Performance, Presentation and Measurement - RETMA STANDARD # REC-141, March 1954, Engineering Department., Radio-Electronics-Television Manufacturers Association.

EMS Communications Plan and Specifications For The State of Wisconsin - Appendix II-A.

So That Others May Live - Division of Emergency Medical Services and Highway Safety, Illinois Department of Public Health

The Critically Injured Patient, Concept and the Illinois Statewide Plan for Trauma Centers, Illinois Department of Public Health, Division of EM services and Highway Safety, David R. Boyd, MDCM Chief, Dr. Bruce Flashner, Ogilvie, Governor Franklin Yoder, MD., MPH., Director Illinois Department of Public Health

Illinois Trauma Care System - Safety Director, Allstate Insurance Company, Northbrook, Illinois 60062

Emergency Care and Transportation of the Sick and Injured - by the Committee on Injuries American Academy of Orthopaedic Surgeons, State Department of Health, Des Moines.

Profile of Hospital Emergency Room Facilities and Services - Siouxland Health Planning Council, Survey Form, Sioux City, Iowa 1972

Iowa Regional Medical Program Ambulance Services Survey,- IRMP, Iowa City, Iowa 1972

Hospital Emergency Departments - Digest of Surveys conducted 1965 to March 1971 by U. S. Department of Health, Education, and Welfare, Public Health Service, Health Services and Mental Health Administration, Division of Emergency Health Services, 5600 Fishers Lane, Rockville, Maryland 20852, May 1971.

Physicians in Hospital Emergency Departments - Proceedings New Jersey Training Program, U. S. Department of Health, Education and Welfare, Public Health Service, Health Services and Mental Health Administration, Division of Emergency Health Services, Maryland 20852, May 1971.

Emergency Medical Services - State Plan for Minnesota, December 1971, Minnesota Department of Health.

The AHA Guide to the Health Care Field - Hospital Building and Equipment Company, Inc. Subsidiary of Kummer Corporation, 9109 Watson Road St., St. Louis, Missouri 63126, 1972.

A Capsule View of the Special State Government Committee Study Report On Telecommunications for Nebraska State Government - Communications for State Government Operations, 1967 "The Feasibility of a Statewide Comm Network" for the State of Nebraska 1965.

Abstracted Information From Communication Study Reports - Memo to File, 10 November 1972, Warren Fackler covering:
(a) An integrated Microwave System for the State of Iowa, December 1966, by Atlantic Research;
(b) A Plan for the Development and Use of Radio, Television and Other Communication Services to Meet State-Wide Educational Needs and Objectives in Iowa, dated June 1966, prepared by the Office of Research and Development, National Association of Educational Broadcasters
(c) An Integrated Communication System for the State of Iowa, Final Report, dated March 1967 by Jansky & Bailey.

Communications Network of the Mississippi Hospital Association - Emergency Operations Manual, 4880 McWillie Drive, Jackson, Mississippi 39206, Prepared by the Communications Network of the Mississippi Hospital Association.

An Areawide Plan for Emergency Medical Services - prepared for Iowa State Department of Health, Emergency Medical Services Section, July 1972, Siouxland Health Planning Council, 101 Pierce Street, Sioux City, Iowa 51101

Radio Data Book - Arcata Communications Information, 561 National Press Building, Washington D.C. 20004, Five (5) Volumes entitled "Fire", "Local Government", "Police and State Guard", "Forestry Conservation and Highway Maintenance", "Special Emergency".

Emergency Medical Services Communications in Iowa, Arnold M. Reeve, Journal of Iowa Medical Society, January 1973. (Report of Commissioner State Department of Health).

§ 89.525 Frequencies available to the Special Emergency Radio Service.

(a) The frequencies or bands of frequencies listed herein are available for assignment to stations in the Special Emergency Radio Service subject to the conditions and limitations of this section.

(b) The amount of separation between assignable frequencies listed in this section does not necessarily indicate the amount of frequency separation required for systems operation; accordingly, grants of adjacent channel assignments in all bands shall be in the discretion of the Commission.

(c) The operation of mobile systems in the Special Emergency Radio Service will be restricted to the use of only one frequency; providing that (1) an additional frequency may be authorized when mobile relay stations are authorized pursuant to paragraph (h) of this section; and (2) one or more additional frequencies in the 460 MHz band may be assigned, as needed, for biomedical telemetry operations in accordance with paragraphs (f)(2), (4), (5), and (8) of this section.

(d) Frequencies indicated normally for base and mobile stations in the Special Emergency Radio Service will be authorized to fixed stations also subject to the condition that harmful interference will not be caused to the mobile service.

(e) The following tabulation indicates the frequency or bands of frequencies, the class of station(s) to which they are normally available, and the specific assignment limitations, which are developed in paragraph (f) of this section:

Frequency or band	Class of station(s)	Limitations
kHz		
2000 to 3000	Fixed	9
2726	Base and mobile	10
3201	do	
MHz		
33.02	do	6
33.04	do	
33.06	do	6
33.08	do	
33.10	do	6
35.64	Base	12, 13, 17
35.68	do	12, 13, 17
37.90	Base and mobile	6
37.94	do	6
37.98	do	6
43.64	Base	12, 17
43.68	do	12, 17
45.92	Base and mobile	15
45.96	do	15
46.00	do	15
46.04	do	15
47.42	do	7
47.46	do	
47.50	do	
47.54	do	
47.58	do	
47.62	do	
47.66	do	
72.00 to 76.00	Operational fixed	3
155.160	Base and mobile	15
155.175	do	16
155.205	do	16
155.220	do	15
155.235	do	16
155.265	do	16
155.280	do	15
155.295	do	16
155.325	do	16, 17
155.340	do	15, 17
155.355	do	16, 17
155.385	do	16, 17
155.400	do	15, 17
460.525	do	1, 2
460.550	do	1, 2
463.000	do	1, 4
463.025	do	1, 4
463.050	do	1, 4
463.075	do	1, 4
463.100	do	1, 4
465.525	Mobile only	1, 8
465.550	do	1, 8
468.000	do	1, 5, 11
468.025	do	1, 5, 11
468.050	do	1, 5, 11
468.075	do	1, 5, 11
468.100	do	1, 5, 11
(For frequencies 952 MHz and above, see § 89.101)		

(f) Explanation of assignment limitations appearing in the frequency tabulation of paragraph (e) of this section:

(1) For two-frequency systems, separation between base and mobile transmit frequencies is 5 MHz.

(2) This frequency may be assigned to dispatch ambulances and personnel operating biomedical telemetry units in this service under an area-wide radio communications plan. This frequency is also available for this purpose in the Fire and Local Government Radio Services.

(3) The frequencies available in the band 72 to 76 MHz are listed in § 89.101(c). These frequencies, which are shared with other services, are available only in accordance with the provisions of § 89.101.

(4) This frequency is available for assignment to hospitals under § 89.503 for communication with medical-care vehicles and personnel equipped with biomedical telemetry capability. Use of this frequency is further authorized for telemetry or voice transmissions from a portable telemetering unit to an ambulance for automatic retransmission (mobile/relay) from a patient to a hospital or other medical-care facility. When using telemetry emission, the continuous carrier mode of operation is authorized for this frequency.

(5) This frequency is available for assignment to operate mobile biomedical telemetry units in ambulances and other medical-care vehicles, or when hand-carried by medical personnel. F2 and F9 emission may be authorized; F3 emission may also be authorized on a secondary basis when required for the telemetering activity. When using telemetry emission, the continuous carrier mode of operation is authorized for this frequency.

(6) This frequency is shared with the Highway Maintenance Radio Service.

(7) This frequency is reserved for assignment only to National organizations established for disaster relief purposes.

(8) This frequency may be assigned primarily for mobile dispatch response by ambulances and personnel operating biomedical telemetry units in this service under an area-wide radio communications plan involving central dispatching on the associated base-mobile frequency 460.525 or 460.550 MHz. When authorized for this dispatch response purpose, this frequency may be used on a secondary basis for the purposes and in the manner set forth in subparagraphs (1), (5), and (11) of this paragraph.

(9) Appropriate frequencies in the band 2000–3000 kilohertz which are designated in Part 83 of this chapter as available to Public Ship Stations for telephone communication with Public Coast Stations may be assigned on a secondary basis to special emergency fixed stations for communication with Public Coast Stations only, provided such stations are located in the United States and the following conditions are met:

(i) That such fixed station is established pursuant to the eligibility provisions of § 89.515 and that the isolated area involved is an island or other location not more than 300 statute miles removed from the desired point of communication and isolated from that point by water.

(ii) That evidence is submitted showing that an arrangement has been made with the coast station licensee for the handling of emergency communications permitted by § 81.302(b) of this chapter and § 89.515(d).

(iii) That operation of the special emergency fixed station shall at no time conflict with any provision of Part 83 of this chapter and further, that such operation in general shall conform to the practices employed by Public Ship Stations for radiotelephone communication with the same Public Coast Station.

(10) This frequency is shared with the State Guard Radio Service.

(11) Mobile stations authorized to operate on this frequency may be used to extend the range of transmission between portable telemetering units and

(12) This frequency will be assigned only for one-way paging communications to mobile receivers. Transmissions for the purpose of activating or controlling remote objects on this frequency are not authorized.

(13) Prior to October 1, 1974, no assignments will be made on the frequency 35.64 MHz within 40 miles of the center of Houston, Texas, Portland, Maine, Charleston, West Virginia, Boston, Massachusetts, and Binghamton, New York; or on 35.68 MHz within 40 miles of the center of Portland, Maine, Boston, Massachusetts, Binghamton, New York, and Charleston, West Virginia. The centers of cities are taken as the reference points indicated on pages 226–238 of the U.S. Department of Commerce publication "Air-Line Distances Between Cities in the United States."

(14) [Reserved]

(15) Available for assignment: ***Provided***, That until further order of the Commission, application is accompanied by a written and signed statement that licensees of all stations, excluding Special Emergency stations, located within a radius of 75 miles of the proposed location and authorized to operate on a frequency 30 kHz or less removed have concurred with such assignment, or is accompanied by an acceptable engineering report indicating that harmful interference to the operation of such existing stations will not be caused.

(16) Available for developmental operation: *Provided*, That

(i) The proposed station location is removed by at least 40 miles from the station location of each other station, not including those authorized to other Special Emergency licensees, which is authorized to operate on frequencies 30 kHz or less removed; and

(ii) The application is accompanied by a written and signed statement that the licensees of all stations, excluding Special Emergency licensees, located within a radius of 75 miles of the proposed location and authorized to operate on a frequency 30 kHz or less removed have concurred with such assignment or is accompanied by an acceptable engineering report indicating that harmful interference to the operation of existing stations, excluding Special Emergency stations, will not be caused, together with a written statement that the licensees of all stations, excluding Special Emergency stations, located within a radius of 75 miles of the proposed station and authorized to operate on frequencies 30 kHz or less removed have been notified of the applicant's intention to request the assignment.

(17) Available for assignment only to hospitals eligible under § 89.503 and to those ambulances which submit a showing that they render coordination and cooperation with a hospital authorized on this frequency.

[*§ 89.525(c) & (e) table amended, (f)(1), (2), (4), (5), (8) & (11) added, and (g) deleted eff. 5-9-72; par (e) table amended, and (f)(12) & (13) added eff. 7-28-72; V(70)-7*]

SUBPART A—GENERAL INFORMATION

§ 17.1 Basis and purpose.

(a) The rules in this part are issued pursuant to the authority contained in Title III of the Communications Act of 1934, as amended, which vests authority in the Federal Communications Commission to issue licenses for radio stations when it is found that the public interest, convenience, and necessity would be served thereby, and to require the painting, and/or illumination of radio towers if and when in its judgment such towers constitute, or there is a reasonable possibility that they may constitute, a menace to air navigation.

(b) The purpose of the rules in this part is to prescribe certain procedures and standards with respect to the Commission's consideration of proposed antenna structures which will serve as a guide to persons intending to apply for radio station licenses. The standards were developed in conjunction with the Federal Aviation Administration (FAA).

§ 17.2 Definitions.

(a) *Antenna structures.* The term antenna structures includes the radiating system, its supporting structures and any appurtenances mounted thereon.

(b) An antenna farm area is defined as a geographical location, with established boundaries, designated by the Federal Communications Commission, in which antenna towers with a common impact on aviation may be grouped.

§ 17.4 Commission consideration of proposed antenna structure with respect to possible hazard to air navigation.

(a) All applications are reviewed to determine whether there is a requirement that the applicant file a Notice of Proposed Construction or Alteration [FAA Form 7460–1] with the Federal Aviation Administration.

(b) Whenever applications require the filing of a Notice of Proposed Construction or Alteration [FAA Form 7460–1] the applicant will be advised to do so unless the application includes an FCC Form 714 certifying that notification has been submitted to FAA or the application form itself specifically supplies all of the information which would be provided on the FCC Form 714.

(c) All applications which do not require the filing of FAA Form 7460–1 with the FAA will be deemed not to involve a hazard to air navigation and will be considered by the Commission without further reference to the FAA.

(d) Whenever a "no hazard determination" is received from the FAA concerning any proposed antenna structure, the antenna structure is deemed not to involve a hazard to air navigation and the antenna aspect of the application for radio station authorization will be processed accordingly; provided that the FAA "no hazard determination" has not expired.

(e) Whenever a report is received from the FAA indicating that a proposed antenna structure is a hazard, the Commission will take further appropriate action.

(f) Applications which show on their face that the antenna structure will extend more than 20 feet above the ground or natural formation or more than 20 feet above an existing manmade structure (other than an antenna structure) shall be accompanied by FCC Form 714 indicating that notification has or has not been submitted to FAA or the application form itself shall specifically supply all of the information which would be provided on the FCC Form 714.

(g) In addition to the other requirements of this part of the rules, each application for a radio station authorization shall include such information regarding proposed antenna construction as may be required by the FCC. Such information is to be supplied on the FCC application form specified in the rules pertaining to the radio service in which application is being made or as may otherwise be required.

SUBPART B—CRITERIA FOR DETERMINING WHETHER APPLICATIONS FOR RADIO TOWERS REQUIRE NOTIFICATION OF PROPOSED CONSTRUCTION TO FEDERAL AVIATION ADMINISTRATION

§ 17.7 Antenna structures requiring notification to the FAA.

A notification to the Federal Aviation Administration is required, except as set forth in § 17.14, for any of the following construction or alteration:

(a) Any construction or alteration of more than 200 feet in height above ground level at its site.

(b) Any construction or alteration of greater height than an imaginary surface extending outward and upward at one of the following slopes:

(1) 100 to 1 for a horizontal distance of 20,000 feet from the nearest point of the nearest runway of each airport with at least one runway more than 3,200 feet in length, excluding heliports and seaplane bases without specified boundaries, if that airport is either listed in the Airport Directory of the current Airman's Information Manual or is operated by a Federal military agency.

(2) 50 to 1 for a horizontal distance of 10,000 feet from the nearest point of the nearest runway of each airport with its longest runway no more than 3,200 feet in length, excluding heliports and seaplane bases without specified boundaries, if that airport is either listed in the Airport Directory or is operated by a Federal military agency.

(3) 25 to 1 for a horizontal distance of 5,000 feet from the nearest point of the nearest landing and takeoff area of each heliport listed in the Airport Directory or operated by a Federal military agency.

(c) Any construction or alteration on an airport listed in the Airport Directory of the current Airman's Information Manual.

(d) When requested by the FAA, any construction or alteration that would be in an instrument approach area (defined in the FAA standards governing instrument approach procedures) and available information indicates it might exceed an obstruction standard of the FAA.

NOTE: Consideration to aeronautical facilities not in existence at the time of the filing of the application for radio facilities will be given only when proposed airport construction or improvement plans are on file with the Federal Aviation Administration as of the filing date of the application for such radio facilities.

§ 17.14 Certain antenna structures exempt from notification to the FAA.

A notification to the Federal Aviation Administration is not required for any of the following construction or alteration:

(a) Any object that would be shielded by existing structures of a permanent and substantial character or by natural terrain or topographic features of equal or greater height, and would be located in the congested area of a city, town, or settlement where it is evident beyond all reasonable doubt that the structure so shielded will not adversely affect safety in air navigation. Applicants claiming such exemption under § 17.14(a) shall submit a statement with their application to the FCC explaining basis in detail for their finding.

(b) Any antenna structure of 20 feet or less in height except one that would increase the height of another antenna structure.

(c) Any electronic facility, the signal of which is used primarily for navigational guidance by aircraft, any airport visual approach or landing aid, or any airport ceiling or visibility indicator device, or other meteorological facility or instrument, approved by the Administrator, the location and height of which would be fixed by its functional purpose.

§ 17.17 Existing structures.

(a) Nothing in the criteria in this subpart concerning antenna structures or locations shall apply to those structures authorized prior to September 5, 1967.

(b) No change in any of these criteria or relocation of airports shall at any time impose a new restriction upon any then existing or authorized antenna structure or structures.

SUBPART C—SPECIFICATIONS FOR OBSTRUCTION MARKING AND LIGHTING OF ANTENNA STRUCTURES

§ 17.21 Painting and lighting, when required.

Antenna structures shall be painted and lighted when:

(a) They exceed 200 feet in height above the ground or they require special aeronautical study.

(b) The Commission may modify the above requirement for painting and/or lighting of antenna structures, when it is shown by the applicant that the absence of such marking would not impair the safety of air navigation, or that a lesser marking requirement would insure the safety thereof.

§ 17.22 Particular specifications to be used.

Whenever painting and lighting are required, the Commission will assign painting and lighting specifications pursuant to the provisions of this subpart. If an antenna installation is of such a nature that its painting and lighting in accordance with these specifications are confusing, or endanger rather than assist airmen, or are otherwise inadequate, the Commission will specify the type of painting and lighting or other marking to be used in the individual situation.

§ 17.23 Specifications for the painting of antenna structures in accordance with § 17.21.

Antenna structures shall be painted throughout their height with alternate bands of aviation surface orange and white, terminating with aviation surface orange bands at both top and bottom. The width of the bands shall be equal and approximately one-seventh the height of the structure, provided however, that the bands shall not be more than 100 feet nor less than 1½ feet in width.

§ 17.24 Specifications for the lighting of antenna structures up to and including 150 feet in height.

Antenna structures up to and including 150 feet in height above ground, which are required to be lighted as a result of notification to the FAA under § 17.7, shall be lighted as follows:

(a) There shall be installed at the top of the tower at least two 100-, 107-, or 116-watt lamps (#100 A21/TS, #107 A21/TS, or #116 A21/TS, respectively) enclosed in aviation red obstruction light globes. The two lights shall burn simultaneously from sunset to sunrise and shall be positioned so as to insure unobstructed visibility of at least one of the lights from aircraft at any normal angle of approach. A light sensitive control device or an astronomic dial clock and time switch may be used to control the obstruction lighting in lieu of manual control. When a light sensitive device is used, it should be adjusted so that the lights will be turned on at a north sky light intensity level of about 35-foot candles and turned off at a north sky light intensity level of about 58-foot candles.

§ 17.25 Specifications for the lighting of antenna structures over 150 feet up to and including 300 feet in height.

(a) Antenna structures over 150 feet, up to and including 200 feet in height above ground, which are required to be lighted as a result of notification to the FAA under § 17.7 and antenna structures over 200 feet, up to and including 300 feet in height above ground, shall be lighted as follows:

(1) There shall be installed at the top of the struc-

ture one 300 m/m electric code beacon equipped with two 500-, 620-, or 700-watt lamps (PS–40 Code Beacon type) both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any normal angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach. The beacons shall be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 12 flashes per minute, with a period of darkness equal to approximately one-half of the luminous period.

(2) At the approximate mid point of the overall height of the tower there shall be installed at least two 100-, 107-, or 116-watt lamps (#100 A21/TS, #107 A21/TS, or #116 A21/TS, respectively) enclosed in aviation red obstruction light globes. Each light shall be mounted so as to insure unobstructed visibility of at least one light at each level from aircraft at any normal angle of approach.

(3) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.26 Specifications for the lighting of antenna structures over 300 feet up to and including 450 feet in height.

(a) Antenna structures over 300 feet up to and including 450 feet in height above the ground shall be lighted as follows:

(1) There shall be installed at the top of the structure one 300 m/m electric code beacon equipped with two 500-, 620-, or 700-watt lamps (PS–40 Code Beacon type) both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any normal angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any normal angle of approach. The beacons shall be equipped with a flashing mechanism producing not more than 40 flashes per minute, nor less than 12 flashes per minute, with a period of darkness equal to approximately one-half of the luminous period.

(2) On levels at approximately two-thirds and one-third of the overall height of the tower, there shall be installed at least two 100-, 107-, or 116-watt lamps (#100 A21/TS, #107 A21/TS, or #116 A21/TS, respectively) enclosed in aviation red obstruction light globes. Each light shall be mounted so as to insure unobstructed visibility of at least one light at each level from aircraft at any normal angle of approach.

(3) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

APPENDIX C DETAILED REGIONAL IMPLEMENTATION COST ESTIMATES

TYPE A COMM CENTER WITH ONE REMOTE BASE

Telephone installation charges	$ 150
Radio remote control unit (tone signalling)	1,500
Tone page (average cost)	500
Tape recorder (2 at $100 each)	200
Emergency power unit	1,200
Comm Center furnishings	1,000
Installation	550
	$ 5,100

TYPE B REMOTE BASE

R/T unit	$ 3,000
Enclosure	700
Emergency power unit	1,500
Installation	400
(This figure does not include the cost of the antenna, tower, coaxial cable and site.)	$ 5,600

TYPE C COMM CENTER WITH COLLOCATED BASE STATION

Telephone installation charges	$ 150
Radio remote control unit	1,500
Tone page	500
Tape recorder (2 at $100 each)	200
R/T unit	3,000
Emergency power unit	1,500
Comm Center furnishings	1,000
Installation	600
	$ 8,450

TYPE D COMM CENTER WITH TWO REMOTE BASES

Same as TYPE A plus:	$ 5,100
Remote control console	1,500
Additional installation	50
	$ 6,650

TYPE E — COMM CENTER WITH LOCAL BASE AND TWO REMOTE BASE STATIONS

TYPE C plus:	$ 8,450
Two remote control consoles	3,000
Additional furnishings for extra equipment and operator	500
Additional installation	50
	$ 12,000

TYPE F — HOSPITAL INSTALLATION (Typical)

R/T unit (4 channels, 50 watts)	$ 1,500
Tone page	500
Remote desk set	350
Remote control console	1,000
Antenna	100
Tower	500
Coax and fittings	100
Installation	500
	$ 4,550

(No emergency power or furnishings included)

TYPE G — COMM CENTER WITH LOCAL BASE AND ONE REMOTE BASE STATION

TYPE C plus:	$ 8,450
One additional remote control console	1,500
Additional installation	50
	$ 10,000

TYPE H — HOSPITAL INSTALLATION SERVING MORE THAN ONE HOSPITAL

TYPE F plus: Remote control console Remote Desk Set for each additional hospital	$ 1,500

(Example: Two hospitals using the same base station equals $4,550 plus $1,500 = $6,050)