STATE OF IOWA

TELECOMMUNICATIONS PLAN

For

LAW ENFORCEMENT AGENCIES

FINAL REPORT

VOLUME I

March 1974

Grantor:	Law Enforcement Assistance Administration
Grant No:	702 73 00 198 23 01
Administered Through:	Iowa Crime Commission
;ee:	Department of General Services Division of Communications

PREPARED BY:

spectra associates inc.
CEDAR RAPIDS, IOWA
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To: The Holder of this book

This volume contains the telecommunications plan and recommendations for a law enforcement communications system meeting national standards which can be implemented by local county and city law enforcement agencies. It provides the state-wide planning required by the Law Enforcement Assistance Administration (LEAA) for communications system implementation.

This plan is made possible through the actions of many foresighted persons who recognized the great need for cooperative development of all law enforcement agencies communications needs.

A tribute is given to those persons who took time from their regular duties to serve with the Law Enforcement Administrators Telecommunications Advisory Committee (LEATAC). They worked actively together and fully cooperated in representing the views of their constituent organizations through their broad experiences. Guidance given to program administration and to the contractor was the greatest single factor in development of this plan.

The persons and the organizations they represent are:

Associated Public Safety Communications Officers
Sergeant Duane Terpenning
Mr. Roy Uffelman

Iowa Chiefs of Police and Peace Officer's Association
Captain Joe Powers

Iowa Civil Defense Division
Mr. Henry Boccella

Iowa Crime Commission, State Planning Agency
Mr. Charles Bendlage

Iowa Department of Public Safety
Mr. Warren Amfahr

Iowa General Services Department, Division of Communications
Mr. L. M. Seiler

Iowa Highway Patrol
Major Jack Beaman

Iowa State Policeman's Association
Captain Donald Hollister

Iowa State Sheriff's and Deputies' Associations
Sheriff Rex Rouse

Signed:

George W. Orr, Executive Director, Iowa Crime Commission

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Stanley J. McCausland, Director, Iowa Department of General Services

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1.0 EXECUTIVE SUMMARY

The development of this communication system plan is the culmination of an evident need. For the past two or more years, little law enforcement communications system modernization has been done in the State of Iowa because of uncertainty in the direction to take. Users of the present system know that the systems are not now performing as reliably, as efficiently, or as cost-effectively as they should and could be.

There is an increasing need for improved radio communications reliability and the ability to handle an increasing quantity of emergency request, data and command messages. National recognition and action to solve this problem has produced a set of standards for communications planning. Reference 1.

The quality of radio communications both within and between law enforcement agencies is worsening rather than improving as desired. This is due largely to the :

(1) Interference of agency radio communications due to the state-wide common usage of a single frequency (37.10 Mhz),

(2) Uncoordinated usage of three available frequency bands has reduced interagency communications. When one agency operates in one band communications are not possible with agencies utilizing another band. Specifically the larger cities have implemented new radio systems in the UHF frequency and the Iowa Highway Patrol is constructing a state-wide integrated system utilizing the high-band VHF. Certain smaller cities and a few counties have changed frequency usage from low-band to UHF or high-band. The result is that adjacent counties and cities lose communications with those which change.

Recognition of these and other problems within Iowa has caused concerned law enforcement agency managers, law enforcement association directors and state officials to merge their concerns and their ideas for correction into the development of a planned program to improve the total state-wide law enforcement communications. Activity to resolve the problems led to formation of the Law Enforcement Administrators Telecommunication Advisory Committee (LEATAC).

The LEATAC organization working with officials from the State Planning Agency (Iowa Crime Commission), the Department of General Services (Communications Division), and the Civil Defense Division developed objectives and a scope of work to plan a systematic program for converting the present inadequate and unreliable law enforcement communications system and the systems involved with other public safety activity into an integrated system which meets the requirements for modern public safety and law enforcement communications.

The objectives and scope of efforts required to develop a statewide integrated law enforcement communications plan was approved by the committee and a contractor was selected by the LEATAC through a review of competitive bids from qualified law enforcement communications system consultants. The scope of effort to develop an integrated state-wide plan was divided into three (3) phases of effort:

(1) Phase I was the survey of existing facilities, the inventory of equipment , the analysis of agency requirements, the development of total city, county, and state communications requirements, and the determination of deficiencies found in the present communications systems,

(2) Phase II utilized the information gathered through the survey and analysis tasks and in this report developed the required system plans to meet the present and future requirements for the law enforcement communications. These plans are developed to utilize as much of the present system as possible and to develop cost-effective capital equipment procurement and operations plans which meets the requirements which were established and approved by the LEATAC. Plans applicable to each agency are developed in this report and are summarized in this section. These are tabulated specifically for each county communications center and for categories of city communications centers. Applications for system implementation financing to the Iowa Crime Commission and State Planning Agency will need to be in accord with the plan guidelines as modified by those responsible for maintaining an ongoing and current status of implementation guidelines,

(3) Phase III of the program is the implementation and construction effort

For specific installations of communications system equipment and the training of dispatchers and agency officers to develop operating procedures which optimize system usage. The resulting operational communication system will be implemented by the cooperative efforts of individual agencies which work together to form joint city - county communications or wider area cooperation in regional groups of law enforcement agencies. This system when implemented will provide law enforcement communications to improve system performance, reliability and will alleviate the problems of inter-agency communications. The system will utilize the available frequency spectrum and will meet the recently established nationwide standards for law enforcement communications developed by the National Criminal Justice Commission Task Force. Reference 1.

The fundamental telecommunications system will:

1. Provide the grade of intelligibility necessary to meet standards for public safety land-mobile communications services.
2. Provide flexible and efficient communications switching and cross linkages between telephone, data, and radio communications links. These communications interfaces shall serve the individual agency and allow inter-communication with the public and between public safety and cooperating law enforcement agencies,
3. Provide highly reliable communications system equipments and a secure operational installation. Reliability of existing systems shall be improved through reduction of co-channel radio interference by providing standby power generation and communications equipment, and will be modified and upgraded to provide the necessary radiating system for radio transmission and reception to provide a reliable signal strength everywhere within the boundaries of agency responsibility,
4. Develop communications centers which can provide law enforcement command and control to meet the standards for law enforcement communications emergency operation and required command and control functions. These centers will operate 24 hours per day/7 days per week, and will provide physical security and an area-wide telecommunications capability,
5. Provide a sufficient number of channels to assure command and control operation and for transferring information requests for data and responsive data summaries, to provide tactical communications between

agency units and between the vehicles of the several agencies, and to allow for the transmissions between mobiles and portable radio units and from these to appropriate agency command and control centers,

6. Provide minimum delay emergency complaint and assistance request handling in a communication center through adequate numbers of emergency telephone lines from the public and cooperating agencies. The request system will be capable of meeting an emergency grade of service under all conditions. The answering delay and response to action requests will be capable of meeting or bettering national standards,

7. Adequate numbers of operating and dispatching positions will be available in order to assure the efficient handling of messages and to achieve a minimum response time for commencing action required by the emergency complaint. This will be based on agency jurisdictional area populations and on the communications standards recognized in the nationwide study.

8. Provide adequate recording of emergency complaint and dispatch actions, message lengths, and rates in order to evaluate that dispatch operations meet adequate performance standards and achieve the desired communication system operational standards.

9. Utilize operators who are trained in efficient operating procedures directed through a Comm Center management policy which will assure that all agencies and all communities served by the center are provided equally consistent and satisfactory services and that the system continues to meet the standards which were established in its design.

1.1 GENERAL PLAN DEVELOPMENT

The development of requirements and present system deficiencies were based on the state-wide survey and upon the national standards for law enforcement system operation which brought into focus the necessary steps which must be taken to develop a total state-wide system plan - a plan which will meet the requirements and allow for specific agency planning utilizing general (generic system) plans applicable to all agencies of the state.

The development of these plans involved the evaluation of several alternate plans which meet the above requirements and could provide a cost effective implementation and operation. The performance of these alternate plans was

shown in terms of their relative costs. These were reviewed with the LEATAC. An Interim Report, Reference 10, records these results. Alternatives ranged from:

1. Upgrading all the present agency Communication Centers, (Comm Centers),
2. Coordinating all communications into one center within a county,
3. The integration and development of regional Comm Centers serving a multiple county function.

On the basis of comparisons of the performance and for capital equipment and operational costs plus expected inter-agency cooperation the LEATAC chose the alternative of plan development for a county-wide operational system. This leads to a considerable economy as compared to upgrading all present installations and offers a much improved operational performance. This system plan furthermore does not offer any barrier to regional consolidation via multi-county communications when further economy and performance needs are recognized fully by cooperating agency boards of managers.

The selection was based upon the ability for all county-wide coordinated systems to perform the necessary functions required to meet operational standards. Also, the county system was recognized to operate at less cost than that of the present multi-agency operations within each county. Operational costs of the county-wide coordinated system will have 18% of the current annual operations costs over that which would be expended if all the present agencies were upgraded. This is a savings of approximately $3,000,000 per year. Equipment cost savings of over $1,000,000 are gained. A recognition was given to further cost improvements if regional Comm Centers can be developed. If this occurred throughout the state, annual operational costs could be reduced by 65% over that of an upgraded present system. This would be less than for the county system. The implications of this direction for plan development was recognized by the members of the LEATAC, the State Planning Agency, and the Chief Communications Division. The Phase II implementation planning efforts were directed to the intermediate communications system having county-wide system operation. However, the direction is shown for integrated frequency planning and regional Comm Center operation for those

counties which cooperatively believe this can be policially and economically feasible to implement.

There is a recognized need for each county to organize a board of managers consisting of representatives of user agencies. Policy development and direction for the Comm Center implementation and its operations will be the responsibility of the board. Adjacent counties may together organize a governing board jointly for cooperative activity which can result in joint Comm Center development planning. Guidelines are being developed by the LEATAC to provide legislative recognition for a corresponding state - wide organization to assist the State Planning Agency, State Director of Communications and the Department of Public Safety in approval of Phase III implementation plans falling within the guidelines established in this study and design.

1.2 GENERAL IMPLEMENTATION PLAN CRITERIA

The criteria on which plans are based, bear a real relationship to the communicating needs of state, county and city law enforcement agencies for which the planning is accomplished. In establishing criteria for the upgrade of the operations and equipment of the present system, several objectives must be considered. A summary of these objectives forms the necessary background for understanding the planned way in which specific agencies relate to each other and to the way the entire state-wide law enforcement communications operation is integrated.

1. Implementation Plan Objectives To Integrate and Upgrade The Present System

   a. Develop upgraded system plans which consider factors of performance and cost having operational functions which meet modern law enforcement communications standards of quality and reliability.
   b. Provide effective utilization of existing communications facilities.

c. Provide an open-ended county-wide system in which technical improvements may be incorporated and where systems expansion toward further regional consolidation is technically and economically feasible.

d. Is compatible with and meets requirements of various funding agencies.

e. Improve upon present communications equipment and siting plans for consolidation and upgrading present communications facilities into county Communications Centers.

f. Incorporate radio channel capability for base/mobile/portable/ aircraft links which can operate on a nationwide Tactical frequency, provide Information Channel access to TRACIS/NCIC/LETS/ data, allow intra-agency routine communication (command and control) traffic, and provide Point-to-Point radio channels.

g. Allow coordination of state, county, municipal and private facilities for law enforcement and inter-agency communications. These include the Iowa Highway Patrol Emergency Medical Services, fire rescue and mutual aid and Civil Defense.

h. Select adjacent county groups each having an aggregate population greater than 35,000 persons. With these groups formed develop a state-wide frequency plan so that adequate radio channels are available with a geographical separation to avoid interference. This selection should provide a consistent treatment of population based radio and telephone message traffic loading to assure communication channels are sufficient to meet standards for utilization and response time. Assure county groups wherein the signal transmission and reception is adequate to meet the required grade of service for mobile-to-base, base-to-mobile and for portable unit operations. Indicate county site coordinates for base stations and remote bases to assure than this requirement will be met.

j. Develop and recommend Comm Center management plans to assure that integrated operations satisfy national standards for procedures, managements, frequency usage, performance and have the financial support to sustain long term operations satisfactory to all user agencies.

k. Provide recommendations for county and integrated regions to establish a public availability for a single number emergency request telephone system, preferably the 911.

l. Recognize the need for cooperative planning with Civil Defense Directors to meet the emergency operations and fallout protection in Comm Center developments.

2. Future System Expansion/Growth Objectives

Provide for the further upgrade and regional consolidation of law enforcement communications systems which meet the approved requirements and provide the following expansion possibilities:

a. Computer control of communications facilities and information systems (TRACIS, computer aided dispatch, etc.),
b. Communications with air-borne vehicles,
c. Automated electronic display of vehicle status and geographical location,
d. Emergency reporting facilities improvements similar to or incorporating the capability of the Bell System "911" emergency call system,
e. Data transmission of information both intra-agency/inter-agency.

The preceeding objectives are followed and expanded in depth in the detailed system planning. This is provided in following sections of Volume I and Volume II for those readers who are intersted in:

1) The detailed requirements for meeting system standards, Section 2.0 Vol II and its generic forms,
2) An evaluation of the present system as compared to the general model and channel necessitated by the detailed requirements, Section 3.5, Vol II,
3) The development of population based radio and emergency request message traffic predictions for each county and major city, Section 4.1.1 Vol II,
4) The selection of county groupings for frequency planning based on the message traffic required channels, radio signal reliability/geographic factors and interference potentials, Section 4.1.1, Vol II,

5) The frequency plan development utilizing available spectrum space in the low-band/high-band VHF and in UHF to provide required radio channels, Section 4.1.2, Vol, II ,
6) Detailed system description for base station functions, Comm Center usage and configuration of telephone system recommendations, and operational/maintenance procedures and other details are contained in various sections of this volume ,
7) Equipment specifications are provided in a separate Appendix to this volume.

The following sections provide the reader a general system description intended to form an acquaintance with its provisions which lead to adapting the plan and applying it to any specific county in Iowa.

1.3 GENERAL SYSTEM DESCRIPTION

Several elements are required to describe and construct a complex system. These elements are both hardware and software.

The hardware elements consist of items for example, such as radio transmitters, receivers, antennas, towers and transmission lines.

Software elements include frequency plans, for operation and control, equipment specifications, diagrams showing equipment interconnection, training documents, and etc. In fact, this report is actually a software item.

The first element of software required in development of a communications plan is the frequency plan. The plan must provide adequate numbers of frequencies to serve the radio channel functions. Each county system can meet objectives and requirements if it provides the following channels:

1. A Tactical (Mutual Aid) channel; mobile-to-mobile and base-to-mobile communications. The Comm Center will operate the only allowed base transmitter in the county on a high-band VHF frequency (155.475 MHz). A high-band mobile radio must be installed in each law enforcement vehicle. These are four (4) channel units,
2. An Information Channel which provides for coordinated information requests (wanted, license checks, criminal records and other information)

provided by local records, state and nation-wide data systems. This channel is accomplished via high-band VHF two-frequency-simplex and employs a state-wide frequency plan to limit interference.

3. A Wide-Area Channel used specifically for mobile-to-mobile communications beyond five (5) miles. This utilizes a repeater and the "LEA" duplex channel available in the upgraded Iowa Highway Patrol System now being implemented. This channel is made available by the IHP radio directorate for use by local law enforcement agencies for inter-agency and intra-agency long range communications.
4. A county or regional Operations Channel utilizing a low-band or high-band VHF state-wide frequency plan. When the high-band Operations Channel is used in the county, it is necessary to install only one mobile transceiver unit per vehicle for the county and local city law enforcement agencies.

   Optionally, a portable unit is recommended for personnel use outside the vehicle and may be mounted in the vehicle to provide additional communications backup.

Cities having populations of 20,000 or more or those with a potential population growth which will exceed 20,000 in the next five (5) to eight (8) years have more Operations and Information channel message traffic than the county system can accomodate at peak traffic periods. This requires use of the UHF frequency spectrum because unsufficient low and high-band frequencies exist for use by cities. Larger cities may require additional Operations Channels and as size increases, additional Information Channels as well.

Any county seat city should cooperate in operations of a joint County-City Comm Center. The criteria and Phase II plan allows cities having populations of 50,000 or more to either cooperate in operation of the county Comm Center or to have an individual Comm Center which provides Operations and Information Channel control sufficient to meet individual needs. State-wide frequency plans for all Operations and Information Channel frequencies are provided in this plan. The Iowa map, Figure 1-1 shows the regions and specific frequency usage to be implemented for low-band and high-band county base stations, mobile and portable units used by county and small cities throughout the state to eliminate the interference prevalent today. More

detailed discussion and tables are provided in Section 2 for counties and cities to use in developing their implementation plans.

The general criteria for state-wide local law communications system upgrade requires establishment of a single Comm Center within each county to provide the communications channels and specific linkages which will serve that county and all the local law enforcement agencies in the county.

Figure 1-2 depicts the general configuration and interconnection of the communications system. The functional system elements are shown for a typical county/city integrated system having an Emergency Medical Services (EMS) Comm Center collocated. Other public safety services may be operated out of this center. The system functional elements are:

- Communications Center, containing data, control, recording and point-to-point telecommunication subsystems,
- Base and/or remote transmitter and receiver subsystems for all radio channels,
- Mobile, portable and airborne vehicular radio,
- Emergency power.

The system design and implementation is open ended in its ability to accept optional configurations of radio channel usage. The fundamental county-city configuration, as depicted in Figure 1-2, is applicable with only minor differences to any of the frequency regions to serve as a Comm Center therein. Primary flexibility is achieved via the addition of UHF Operations and Information Channels in larger city usage. Either an existing low-band Operations Channel may be used and/or a high-band Operations Channel implementation is used for the county system.

The county Comm Center will control transmitters and base receivers for the county-wide Tactical Channel, Operations Channel, and the Information Channel. The county Comm Center, through a base station transmitter and monitor receiver, controls the Tactical Channel usage and is responsible for observance of discipline in accordance with the rules and regulations approved and regulated by the Department of Public Safety. The base station receivers, except for the Tactical Channel, will employ a continous tone code squelch (CTCS) decoder. Mobile

units will transmit, except when using the Tactical Channel, a specific sub-audible tone (CTCS) which is assigned to regions established in the frequency plan. The assigned CTCS tone will be utilized both for the Operations Channel and Information Channel whereas another tone is required to match the Iowa Highway Patrol frequency plan when using the Wide-Area Channel. CTCS tones eliminate nuisance interference.

A fundamental requirement and pivotal criteria requires installation of a high-band radio transmitter/receiver in all law enforcement agency vehicles to achieve a state-wide and nationwide Mutual-Aid (Tactical) channel for emergency communications both within an agency and to any other law enforcement agency in the community.

Table 1-1 provides a summary listing and brief description of the population based Comm Center and channel configurations allowed in the implementation plan. The radio system implemented in accordance with these channel configurations and allowable optional usage of low-band and high-band frequencies for Operations and UHF in cities makes possible a meeting of communications requirements which have not been met previously in Iowa. Furthermore, this system includes the Tactical (Mutual-Aid) Channel being developed nationwide after the precedence of the Illinois State Police Emergency Network (ISPERN)and similar networks in North Dakota, Minnesota, and Wisconsin.

1.4 GENERAL IMPLEMENTATION PRIORITIES

Implementation planning must consider several items of priority and there are decisions which need to be made by County Boards of Supervisors, Sheriffs, Public Safety Directors and Police Chiefs who are responsible for construction of the county-wide communication systems in accordance with this plan.

The LEATAC requested trial development of Phase II implementation plans for Sioux City/Woodbury County and for Burlington/Des Moines County consisting of detailed equipment lists, equipment specifications, budgetary estimates, and detailed site studies. Procurement action of equipment for these is awaiting plan approval. The initial installation of these systems is important to achieve a needed improvement in communications system performance in these counties, to demonstrate the superiority of the new system operation and to commence station license request activity to firmly establish the frequency plan with the FCC.

The first implementation priority is to achieve operation of an interference-free frequency plan. This is especially needed in those counties which now use only a single frequency (37.10 MHz for all radio communications). This can be accomplished rather easily and inexpensively through a frequency change in the base station and mobile units in strict accordance with the low-band frequency plan shown in this report.

A second and highly important priority item for meeting a fundamental requirement is to purchase and implement the high-band Tactical Channel radio system. This involves purchase and installation of county and city mobile high-band radio units and a county high-band base station transmitter and receivers. This transmitter is switched to provide the Information Channel base transmission and can be used for the Point-To-Point Channel. It is recommended that the State Planning Agency and the Iowa Crime Commission make application to the LEAA for funding to develop this system for all counties which agree to upgrade their operations to meet the requirements

of this plan and to operate the Tactical Channel in accordance with governing rules and regulations which are formed under the authorization of the Iowa Commissioner of Public Safety. Prior to ordering and installing the Tactical Channel equipment, a decision to select a low-band or high-band Operations Channel utilization must be made by each agency.

The decision to change to the high-band channel must be based on the county's assessment of the reliability of its present low-band system:

1. If a majority of the mobile radios are beoming marginally serviceable,
2. If the base station equipment is old and needs to be modernized,
3. If the detailed plans require an increase in tower height, a change in antennas and/or a site location change to achieve reliable coverage in the county, then utilization of the high-band Operations Channel is in order. When the high-band Operations Channel is used there is available a backup transmitter should the Tactical Channel transmitter become inoperative.

After this decision is made by the county management, it is recommended that adjacent counties be made aware of the decision and thereupon all counties within a frequency plan region should engage in consideration of possibilities for a multi-county Comm Center in accordance with the detailed regional frequency planning and the regional system upgrade discussed in Section 4.0 of Volume II.

As a part of the planning within a county, it is recommended that the sheriff, the Chief of Police of the county seat, and city police chiefs of all the cities in the county become aware of the implications of joint operations. Modifications and license changes of the base and mobile equipment are required in many counties to operate in accordance with the low-band frequency plan, and addition of the high-band multi-channel radio units into all county vehicles is necessary. It is recommended that the county sheriff's office be responsible for submitting grant requests via the Area Crime Commission Directors or supplying information to the procuring department and

initiating the necessary activity to obtain these radios for the city law enforcement agencies of the county.

After the foregoing decisions have been completed, it is important that the specific county and city implementation plans be detailed in grant requests. Budgeting and cost estimates are required. Several system elements and equipment options are provided in the specific agencies requiring these must prepare individual usage justifications based on meeting their operational requirements. Estimates are shown in the next section for overall budget planning of state and federal agencies to implement the basic plan on a five year upgrade schedule.

1.5 TIME PHASED GENERAL IMPLEMENTATION SCHEDULE AND BUDGET

The specific schedule for implementation of specific county and city systems is dependent upon agency applications for funding, the availability of funding and the priority placed upon specific implementation elements.

Priorities discussed in the previous sections are based upon solving the major problems of the present system operations,

The time period over which the implementation should occur, of course, depends upon available budgets at the local, state, and federal levels and the following scheduled dates are provided for their guidance in planning the upgrade. A concerted effort must be made to provide adequate financing to achieve priority implementation approximately on the following schedule:

(1) Example system implementation - 1974,
(2) Frequency plan changeover - 1974/1975,
(3) Tactical Channel subsystem implementation with high-band mobile unit installation based upon the Iowa Highway Patrol Radio System upgrade - 1974/1975 ,
(4) City Operations Channel implementation - 1975/1978,
(5) 911 Emergency request implementation of major population centers throughout the period,
(6) Regional consolidation which will occur during the implementation. The value of this will be increasingly

recognized as the cost of operations for marginally utilized facilities undergoes continued inflationary pressure. Therefore, a high degree of favorable weighing should be given to those cooperating agencies which recognize the value of regional Comm Centers and submit requests accordingly.

The cost estimates and schedule for implementation is shown in Figure 1-3 as a guide to the overall budgeting of the State Planning Agency and of all law enforcement agencies which may require various sources of revenue to finance the system upgrade.

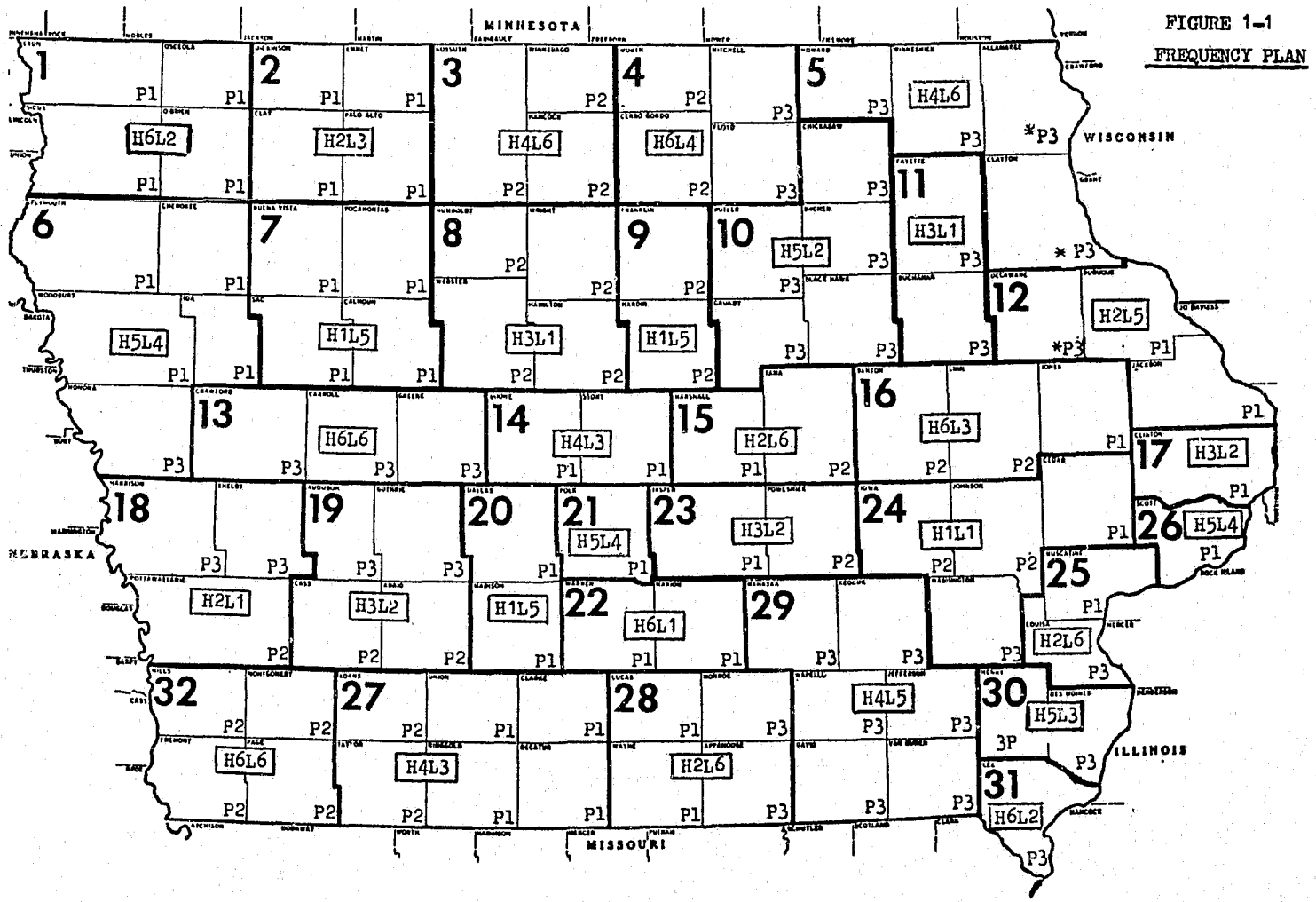
Figure 1-3 costs are based upon budgetary estimates developed in Volume II and are marked up 7% per year to offset inflation and have an added 10% contingency. They show the approximate breakdown of basic subsystem equipments, included in the yearly expenditure. A major cost element is in implementing the Tactical Channel subsystem, especially to acquire the mobile and portable equipments. It is, of course, very important to install the high-band mobile radio and Tactical Channel base station equipments to achieve needed inter-agency communications. Secondary, but quite important, is the acquisition of an additional complement of high-band portable radio units for county intra-agency out-of-car communications. Accordingly, the cost of portable units for county officers is moved outward in time by one (1) year from that of mobile procurement. It is recommended that actual first year procurement budgets allow purchase of approximately one portable unit for each five (5) mobile units.

Twenty counties now have their low-band Operations Channel on the correct frequency and do not have to change low-band frequencies. Costs are estimated based upon fifteen counties electing to change to high-band during the period of 1974 through 1977. Some of these have a low radio channel utilization and may have entirely adequate channel performance through use of the Information Channel to serve both Operation/Information Channel base-to-mobile communications activities. However, the latter

option does not provide a stand-by transmitter for the Tactical/Information Channel, therefore, is not a recommended long term implementation alternate and is not estimated in cost formulation.

FIGURE 1-1

FREQUENCY PLAN



HIGH BAND REGIONAL FREQUENCY SETS

SET NO.	BASE TX/RX OPERATIONS	INFORMATION
H1	154.725	155.250
H2	154.830	155.310
H3	154.845	155.520
H4	155.010	155.535
H5	155.070	155.580
H6	155.190	155.610

LOW BAND BASE

SET NO.	OPERATIONAL
L1	37.08
L2	37.12
L3	37.14
L4	37.16
L5	37.20
L6	37.24

IHPR FREQUENCY SETS
"WIDE AREA" MOBILE IHPR

AREA NO.	TRANSM.	RECEIVE
P1	154.770	155.790
P2	154.890	155.685
P3	154.800	155.700

* This Area No. is subject to modification. Consult Highway Patrol Radio Communications Director.

Mobile Transmit 155.910 (See Table 2-1 for exceptions)
Portable Transmit 155.850 (See Table 2-1 for exceptions)

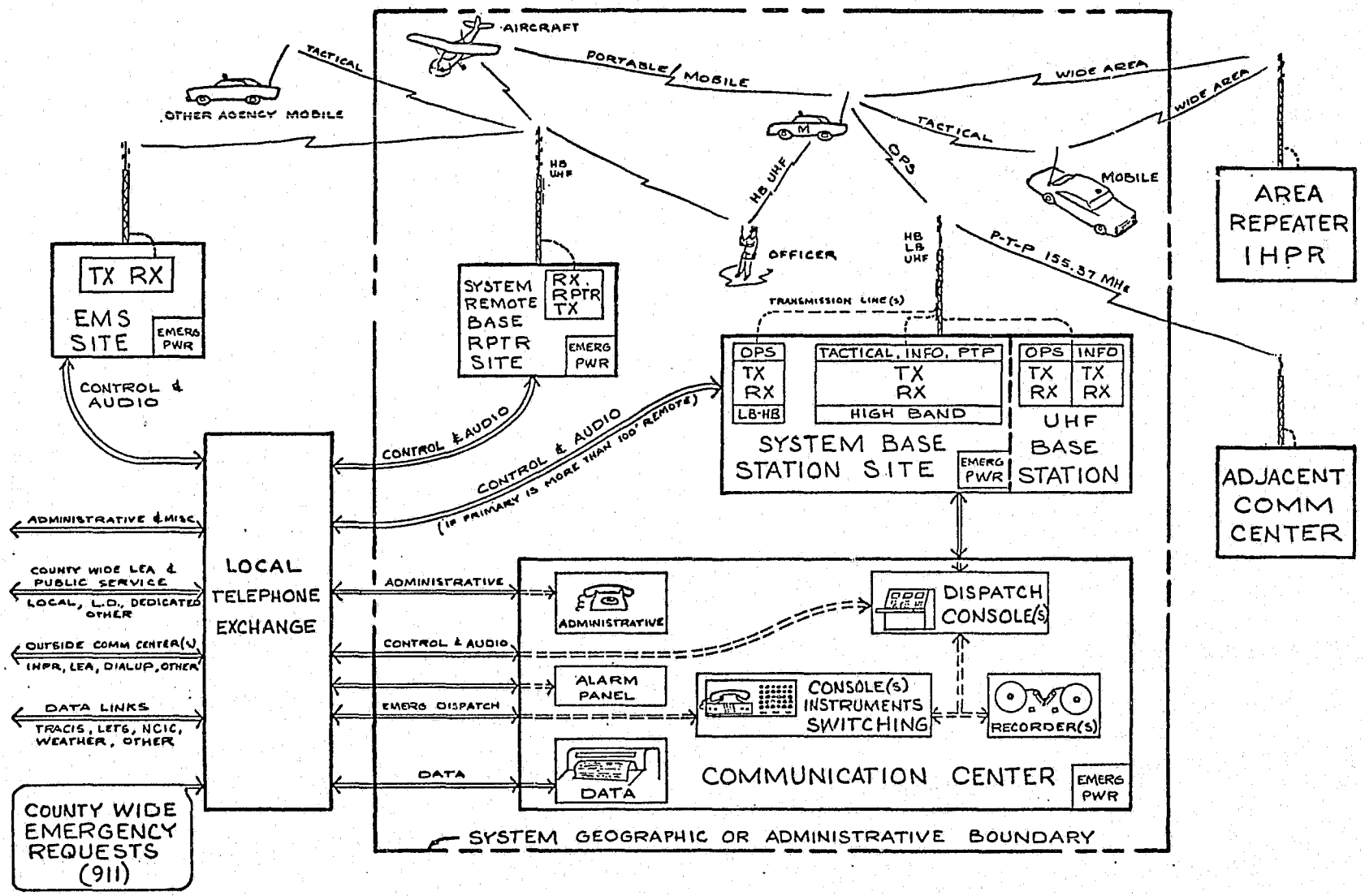
Table 1-1 COUNTY/REGION COMMUNICATION SYSTEM GENERIC CATEGORY

Generic Designation	Population* Distribution	Frequency Band				Population Served by Communication System
		Tactical	Operations		Information	
			County	City		
1 A	LPD	HB	LB	LB	HB	All county and city population within jurisdictional area boundaries
1 B		HB	HB	HB	HB	
2 A	MPD	HB	LB	LB	HB	All county and city population within jurisdictional area boundaries, however one or more separate city communication system (s) may exist within area boundaries. See 3B/C
2 B		HB	HB	HB	HB	
2 C		HB	LB	UHF	HB	
2 D		HB	HB	UHF	HB	
3 A	HPD	UHF	N.A.	UHF	UHF	City only, 50,000 and larger population.
3 B	MPD	UHF	N.A.	UHF	N.A.	City of 20,000 to 50,000 population associated with nearby HPD city.
3 C	MPD	UHF	N.A.	UHF	N.A.	City of less than 50,000 population associated with a county (region) communication system.
4 A	HPD	HB/UHF	LB/HB	UHF/LB	HB/UHF	All county and city population within jurisdictional area boundaries, may include several counties; one or more separate city communication system (s) may exist within area boundaries.
4 B		HB/UHF		UHF	HB/UHF	

* LPD: Low Population Density: Rural - No single city within county (or region) individually exceeds 20,000.

MPD: Medium Population Density: Rural and Urban - A single city within county (or region) may exceed 20,000 pop.

HPD: High Population Density: Rural and Urban - One or more individual cities in area with population over 50,000 and adjacent incorporated cities with over 20,000 population.



A GENERALIZED COMM SYSTEM FOR IOWA FIGURE 1-2

ESTIMATED COSTS BY YEAR
FOR
EQUIPMENT PROCUREMENT

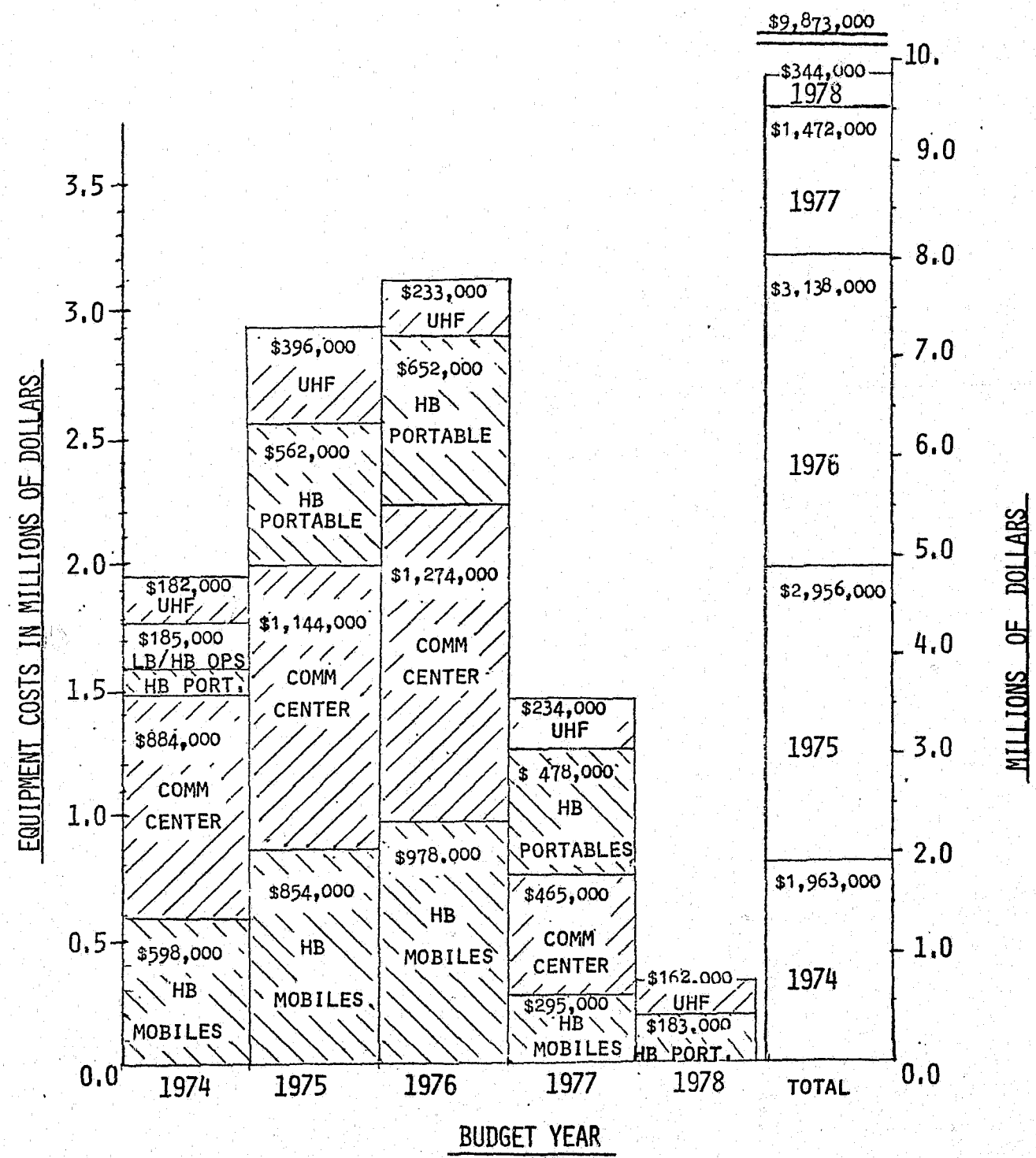


FIGURE 1 - 3

2.0 SYSTEM IMPLEMENTATION

This section is intended to provide a general understanding of the specific hardware utilized in typical installations. Following this, generic agency subsystems equipment lists are provided to aid those persons responsible for making specific agency communications plans, requesting grants and developing procurement papers.

2.1 GENERAL IMPLEMENTATION CONFIGURATIONS

The general system and equipment configuration is graphically described in Figure 1-2 of the previous section. Generic variations of system designs are determined largely by population especially for the Operations and Information Channels in city usage. Table 1-1 shows the system generic implementation possibilities based on three population categories.

The basic system configuration for the county system serving any county having small cities, is essentially everywhere the same. Several subsystem elements of equipment make up the communication system. The equipment is listed functionally as follows:

(1) The operations and command/control center equipments, residing in the Comm Center are:
   (a) Dispatch/operations consoles
   (b) Telephone emergency subsystem and instruments providing the handsets and switching for incoming and outgoing calls
   (c) Recorders, records storage and officer status subsystem
   (d) Data terminal(s)

(2) The base station radio transmitting and receiving equipments which are interconnected with the control consoles are:
   (a) Operations Channel either low-band, high-band or UHF band
   (b) Information Channel
   (c) Tactical Channel
   (d) Point-to-point Channel

(3) The telephone subsystem has four (4) primary functions:
   (a) Answering instruments for emergency request incoming lines from the public and from other agencies. These may be

associated with a "911" emergency request system or 7 digit emergency numbers which are either dialed from the local area or may be dialed long distance from anywhere within the county or multicounty area

(b) Outgoing lines to other law enforcement agencies to inform of action taken or required coordination

(c) Control and audio lines for remote base or repeater equipment sites

(d) Administrative lines for intra and inter-agency usage.

(4) Recording is provided for all emergency incoming and outgoing lines and for the radio channels so that each may be recorded when messages are transferred onto these lines. It is believed unnecessary to record administrative lines and furthermore the administrative telephone subsystem is separated from the instruments which constitute the emergency incoming and outgoing systems.

(5) Emergency power generators to provide stand-by power generation if public utility service power is interrupted in supplying the Comm Center and base station power.

Following sections describe the total system by developing the equipment functions and descriptions for each of the subsystems which are appropriately related to each generic system application. Specification lists and a worksheet method is included for use by agencies to list their specific implementation needs.

2.1.1 COUNTY RADIO COMMUNICATIONS SYSTEM

The county communications system is planned to provide compatible operation of the Tactical/Information/Point-to-Point (TIP) and Operations Channel radio system with two antennas mounted on one tower. Figure 2-1 shows a block diagram of the major equipment components and their basic interconnection when the high-band Operations Channel is employed. A specific description of these equipments is given in later sections. The system frequency plan listed in Table 2-1 provides the nucleus for the system design and truly establishes many of the requirements for the system hardware needed. This table must be applied as recommended for it is a state-wide frequency plan recommendation for each county in low-band and high-band Operations Channel, the high-band

Information Channel, the CTCS tone frequency for each, and provides the Wide-Area Channel transmit and receive frequency thus allowing the mobile units to use the Iowa Highway Patrol repeater system (LEA frequency set). Additionally, this table provides the Wide-Area CTCS tone or tones. Fifteen (15) counties require the use of two tones while the others utilize a single tone which is switched automatically when the Wide-Area Channel is engaged. Both a mobile-transmission Information Channel frequency and a portable unit transmission frequency is listed. This table can be used also for license application preparation.

A single multi-frequency high-band transmitter provides the (TIP) Tactical, Information and Point-to-Point Channels. Individual receivers are needed for each frequency link; includes the Tactical, mobile transmitting on Information, the Point-to-Point Channel, the portable transmitting frequency and the Information Channel base transmitter frequency receivers. Should the low-band Operations Channel (recrystalled per the frequency plan presented in this report) be retained for the county-wide use, the Operations Channel on high-band would usually not be implemented until the low-band usage is terminated. The equipment lists for the high-band systems have been prepared to allow the TIP system to be installed first and the high-band Operations Channel system to be added at another time.

An option for sparsely populated counties wanting to upgrade their system is to utilize the high-band "Information" Channel for both Operations and Information until the traffic load and/or budget availability allows the implementation of a separate Information and Operations Channel. Under this option, the low-band Operations Channel could be phased out, thus requiring only one high-band mobile radio in the patrol car to provide all the necessary communications functions. The basic TIP Channel subsystem is required to operate independently of the Operations Channel subsystem. This allows flexibility in Operations Channel utility in county-wide routine communications. The principal requirement regardless of which bands are used is to adhere strictly to the frequency plan for Operations and Information Channels.

Table 2-2 lists the equipment required to implement the high-band TIP base station. Specifications referenced are in the Appendix volume. This subsystem configuration is used state-wide in conjunction with every county

or even in multi-county communications systems.

When the high-band Operations Channel is used a notched filter and a separate antenna is required as shown in Figure 2-1. Specifications for these are listed in Table 2-6 defining the Operations Channel equipment lists. These filters are not purchased as a part of the TIP system, unless it is known that high-band operations will proceed. The filters allow simultaneous transmission on the Operations Channel and reception of the TIP Channels, and conversely, reception on the Operations Channel while transmitting on one of the TIP channels.

Table 2-12A/B lists recommended VHF high-band mobile and portable channel switching combinations. These should be followed to assure consistent applications state-wide (especially for mobile and aircraft units).

2.1.2 COMM CENTER

The selection of a Comm Center location is largely a matter of ability to obtain physical security and convenience for user agencies although it is economically advantageous to locate it at the site of the base station to avoid radio system remote control. Collocation with the major user agency headquarters is highly desired for this provides uniformed supervisory staff convenient for emergency and strategic control situations.

The floor space required is based upon:

(1) Number of operator positions required
(2) File and record space
(3) Supervisory personal work station
(4) Restroom facilities
(5) Visitor entry area
(6) Emergency power
(7) Equipment floor space i.e. data terminal recorder, console (s), radio systems and telephone PBX.

Volume II Section 4.2.1 provides more detailed estimation criteria for layout and design of the Comm Center.

Table 2-3 lists the Comm Center typical equipment installed.

2.2 GENERIC SYSTEMS

2.2.1 GENERIC I LOW POPULATION COUNTIES

A typical base station subsystem in the 82 low population counties in Iowa consists of an Operations Channel (either low or high-band) and the TIP channel equipment installation discussed in the previous paragraphs. Figure 2-2 shows subsystem relationships.

The decision to remain on low-band in conformity with the county system frequency plan is required of the county law enforcement agency officials in their assessment of the need to upgrade existing facilities. Generally, if the existing equipment is modifiable and signal reliability is adequate, from existing radiating facilities, then remaining on the low-band Operations Channel is most cost effective.

This generic county system will have the following functions:

1. A primary Operations Channel on either low-band or high-band VHF. Existing low-band channel may be retained if it is used for local government interface.
2. A TIP equipment subsystem.
3. A Comm Center which provides dispatcher services 24 hours a day. TRACIS terminal, audio recordings of all complaint/dispatch activity, and controls for all the radio communications links installed. The Comm Center, of course, is also the terminal for the incoming emergency telephone lines for the public to request assistance. The Comm Center equipments required generally in each system are listed in Table 2-3.

Table 2-4 shows specific details for antenna site locations (by coordinates) the heights of antennas, antenna types, orientation for directional arrays, and provides specification references to the Appendix of this volume for each county system. This table provides the input data for site planning, which with close adherence will assure performance of the resulting system assuming that all Comm Centers are coordinated and co-located according to the generic configurations of the plan.

The content of each column in the Table is described as follows:

Antenna Location Name

Where it is necessary to relocate the transmitting antenna tower site. The entry approximately describes the new location when required with respect to direction, distance to closest community, etc.

Antenna Latitude and Longitude

The relocated antenna tower sites geographic coordinates are listed. The tolerance for actual site selection is ± 2 minutes from these coordinates to allow for land acquisition.

Tower Base MSL

The tower base elevation above MSL (Mean Sea Level) is given for all locations, new and existing, to provide a guide for tower relocations. If an available site within the coordinate tolerance has an MSL 10 feet less than shown in the tabulation a corresponding compensating tower height increase is required.

Tower Height Feet

The tower height figures are listed for both the existing structures and those which are new (marked with an asterisk) to provide the required propagation signal reliability for the county.

NOTE: Many of the existing antenna towers are probably inadequate to support the two antennas required. A qualified professional should inspect the existing tower. The tower must be properly rated to ensure a hazard-free installation. Water towers are used by many agencies for the antenna support structure. A continued use of the local water tower for supporting the antennas is feasible under the following conditions:

(1) When the Generic 1 system configuration is used, i.e. low-band Operations Channel and high-band Tactical/Information Channels, antennas should be mounted such that the active parts are clear and free of the water tank top. In addition, the low-band and high-band antennas are mounted on opposite sides of the tower.

(2) When the antenna effective height is according to the tabulated value. Some county systems are currently being operated at excessive antenna heights which cause the signals to be propagated much farther than necessary and, hence, in the new system would cause needless interference in the nearest co-frequency region. The water tower structure does not allow reliable radiation patterns when the antenna is mounted from the sides of the tank from its supporting legs. If compliance with above requirements is not possible, an antenna tower must be constructed which complies with heights listed.

Radiation Center HB #1 Antenna

This antenna identified in Figures 2-3, 2-4, and 2-5 is a high-band antenna with radiation center height listed above the base of the tower (e.g., site elevation above MSL). For installations which will retain the low-band Operations Channel, this antenna is used for the TIP Channels.

Radiation Center HB #2 Antenna

The second antenna radiation center height is listed for the high-band Operations Channel and provides the spacing required between the two high-band antennas for simultaneous channel operations. The radiation center height listed is that which is used to side mount a dual dipole low-band array which is the recommended low-band Operations Channel antenna. As indicated previously, the water tower antenna support structure is not satisfactory for supporting two high-band antennas for which vertical spacing for isolation (45 dB required) is necessary - hence, counties desiring to implement high-band for all channels must erect a communications antenna support tower having the recommended height.

Antenna Type LB, HB #1, HB #2

These three columns provide a reference to antenna types by specification identities (see Appendix - Equipment Specifications) and also provides, when required, the orientation angles of the radiation pattern with respect to the direction of maximum gain. The antennas specified are designed to mount on standard communications antenna towers. For those counties in which the Generic 1 System is implemented and in those situations where a water tower structure is used to support both the low-band and high-band antennas, the low-band antenna specification reference will be D-9

(a half-wave, coaxial, vertical) instead of the D-8 or D-8a which requires typically forty (40) feet of vertical tower span for mounting.

Water tower structure availability and excessive antenna effective heights are identified in the Tower Heights column where known. Information which must be determined prior to antenna and tower site planning decision completion is as follows:

(1) Availability of water tower and antennas towers known to be adequate for mounting of antennas,
(2) Management decision to utilize a low-band or high-band Operations Channel,
(3) The city management decision to employ UHF Operations and Information Channels at the same site.

The low-band Operations Channel usage requires that there is adequate, reliable equipment for meeting the provisions listed in Table 2-5 and the requirements of Table 2-4. Mobile units, of course, must have the frequency change shown. Figure 2-3 diagrams the antenna layout recommended for the low-band Operations Channel configuration.

High-band Operations Channel usage requires provision of equipments as listed and specified in Table 2-6 with locations of towers and antennas as shown in Table 2-4. A complement of filters is required to attenuate the products of simultaneous operations from affecting the two radio base station subsystems. If these are not used, the performance of each subsystem can be degraded seriously. The antenna configuration of Figure 2-4 diagrams the recommended installation for the tower. The Comm Center requires an added control console for the high-band Operations Channel transmitter and receiver.

2.2.2 GENERIC II — COUNTIES WITH POPULATION OF CITIES >20K But <50K - COMBINED COUNTY-CITY SYSTEMS

In counties having a large population resulting from larger cities, the communication system is essentially the same as for low population counties. Additional operating positions need to be available at the Communication Center and city Operations Channels are UHF. The cost effectiveness and

the degree of cooperation attainable between the county-wide law enforcement and county seat municipal police will determine the evolution of systems implementation. Typically, it is more cost effective for all agencies to share the Comm Center. Table 2-7 lists the system hardware for a combined county/city (with population between 20K and 50K) communication system. Figure 2-5 details the recommended antenna mounting configuration for this generic system. Figure 2-6 diagrams subsystems for this generic configuration.

2.2.3 GENERIC IV COUNTIES WITH POPULATION OF CITIES >50K - COMBINED COUNTY-CITY SYSTEM

The combined county/city system in high population counties is much like that of the medium population areas. The general system configuration is diagrammed as Figure 1-2. Control console equipment quantity and personnel requirements are listed in Table 2-8. System Comm Center layout and construction is somewhat different for the specific system configuration. The number of dispatch positions (control consoles) and radio links required are shown in Table 2-8 as if the large city systems have a separate Comm Center, however, as shown in Figure 2-6 combinations of centers will allow operational cost savings to occur. Hardware lists are those of Section 2.2.2 (which details the county radio system hardware via Table 2-7) and an addition of the UHF Operations and Information Channel radio subsystems of Table 2-11B. The UHF frequency plan for cities is listed in Table 2-9. The antenna locations, tower heights and the transmitter power together with satellite receiver requirements are listed in Table 2-10.

The antenna configuration for the combined systems is diagramed in Figure 2-5 and installation should proceed as shown with care taken to assure that the orientation of antenna elements for each installation meets Table 2-4 and 2-10 requirements.

2.2.4 GENERIC III CITY UHF OPERATIONS AND INFORMATION CHANNEL SYSTEMS

The generic UHF communication system is divided into two types of systems for description - - the one channel system applies to the cities with 20-50K

populations (Option 3-B), and the multi-channel system applies to cities having greater than 50K population (Option 3-A). Sioux City and Burlington UHF systems have been planned in detail by Spectra for early implementation. Sioux City is representative of the Option 3-A system. Details for their systems implementation are found in Appendix A of volume II. Table 2-11A and 2-11B with Figure 2-7 shows the two basic or generic UHF system options which are referenced for each city in Table 2-10. Figure 2-7 shows a typical configuration.

The duplex frequency pairs allow functioning of a mobile repeater subsystem at each base or remote base where there is a receiving and transmitting subsystem. The repeater mode is switched on or off at the Comm Center. In specific installations when statellite receivers are used it is possible to utilize the best receiver output to drive the repeater transmitter for a particular link. The specific installation details must be configured for the specific agency during the implementation phase. See Appendix A Volume II, for example as applied to Sioux City.

Table 2-13 lists recommended combinations of channel switching for the UHF portable/mobile/aircraft units. Decisions at the local level will be required prior to ordering equipment to ensure having a capability in the system which provides the desired operational modes for the using agency. The frequencies or modes of operation can be changed to some degree at a later date, but it is then not cost effective.

2.2.5 REGIONAL SYSTEMS

Many counties and the cities in them will want to consider development of a single regional cooperative Comm Center and provide for their law enforcement agencies dispatch. The optimum utilization of regional planning is to construct one jointly operated Comm Center in each frequency planning region. The approximate base station site locations for these regions are listed in Table 2-14 providing required tower heights, power and antenna gain/directivity. Traffic intensity values are shown in Table 4-2 of Vol II.

The regional system design is not completed beyond showing feasibility and that the generic subsystem configurations are applicable. Specific site locations must be cost effectively selected for tower heights and the Comm Center design must be developed in equivalent detail as in this report.

FIGURE 2-1 HIGH-BAND COUNTY-WIDE BASE STATION SUB-SYSTEM

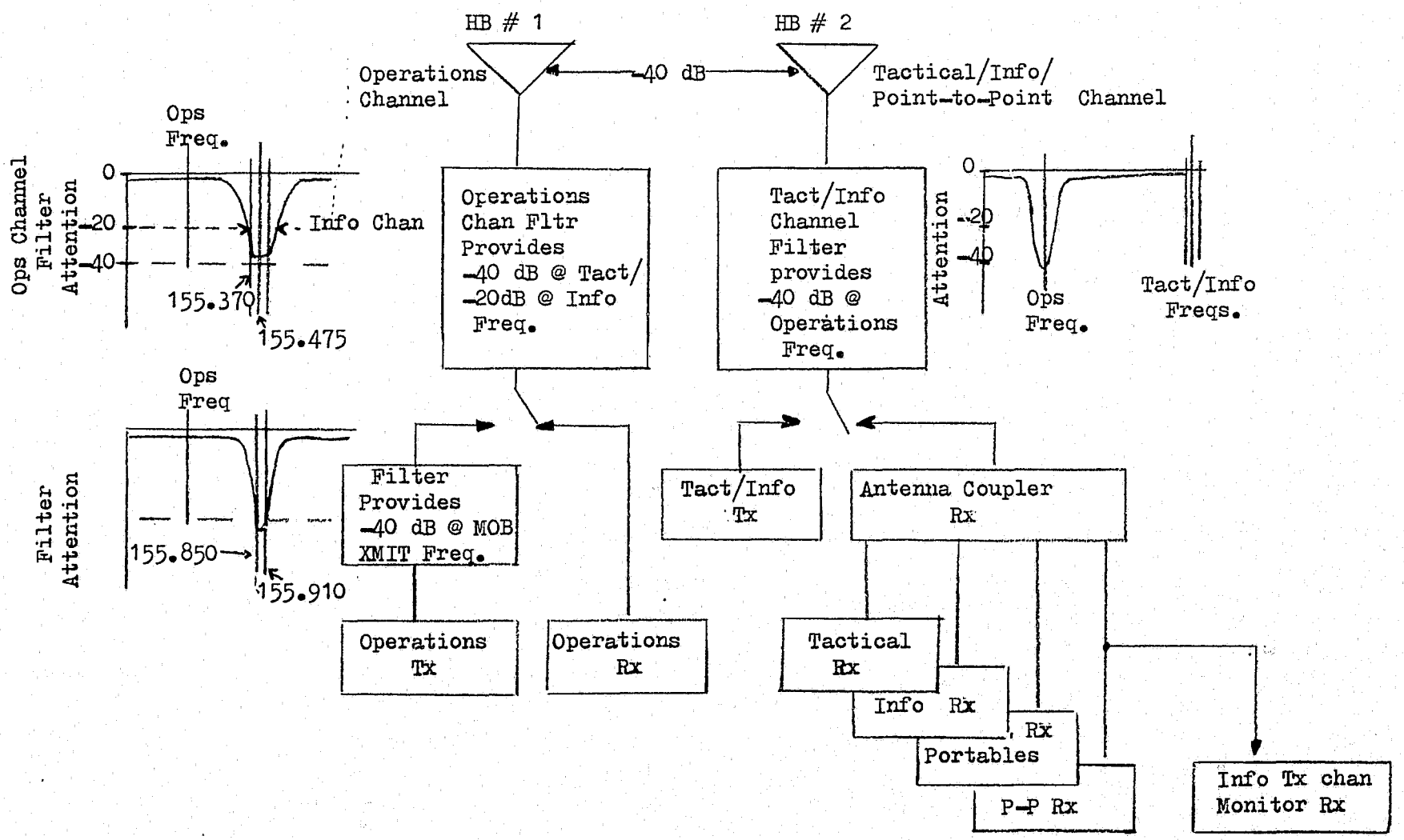


Table 2-1 CHANNEL AND CTCS FREQUENCIES - COUNTY SYSTEMS

COUNTY	REG	COUNTY (CO. SEAT)	BASE STATION TX/RX LOW-BAND OPERATIONS	BASE STATION TX/RX HIGH-BAND OPERATIONS	BASE STATION TX HIGH-BAND INFORMATION	BASE STATION CTCS FREQUENCY Hz	MOBILE TX WIDE AREA	MOBILE RX WIDE AREA	MOBILE WIDE AREA* CTCS Freq.	MOBILE INFORMATION	PORTABLE TX
1	19	ADAIR (GREENFIELD)	37.12	154.845	155.520	146.2	154.890	155.685	146.2/192.8	155.910	155.850
2	27	ADAMS (CORNING)	37.14	155.010	155.535	137.3	154.890	155.685	146.2	"	"
3	5	ALLAMAKEE (WAUKON)	37.24	155.010	155.535	167.9	154.800	155.700	192.8	"	"
4	28	APPANOOSE (CENTERVILLE)	37.24	154.830	155.310	167.9	154.800	155.700	146.2	"	"
5	19	AUDUBON (AUDUBON)	37.12	154.845	155.520	146.2	154.800	155.700	127.3/192.8	"	"
6	16	BENTON (VINTON)	37.14	155.190	155.610	192.8	154.890	155.685	167.9	"	"
7	10	BLACKHAWK (WATERLOO)	37.12	155.070	155.580	167.9	154.800	155.700	146.2	"	"
8	14	BOONE (BOONE)	37.14	155.010	155.535	167.9	154.770	155.790	146.2	"	"
9	10	BREMER (WAVERLY)	37.12	155.070	155.580	167.9	154.800	155.700	146.2	"	"
10	11	BUCHANAN (INDEPENDENCE)	37.08	154.845	155.520	127.3	154.800	155.700	146.2	"	"
11	7	BUENA VISTA (STORM LAKE)	37.20	154.725	155.250	167.9	154.770	155.790	127.3	"	"
12	10	BUTLER (ALLISON)	37.12	155.070	155.580	167.9	154.800	155.700	146.2	"	"
13	7	CALHOUN (ROCKWELL CITY)	37.20	154.725	155.250	167.9	154.770	155.790	127.3	"	"
14	13	CARROLL (CARROLL)	37.24	155.190	155.610	192.8	154.800	155.700	127.3	"	"
15	19	CASS (ATLANTIC)	37.12	154.845	155.520	146.2	154.890	155.685	146.2	"	"
16	24	CEDAR (TIPTON)	37.08	154.725	155.250	167.9	154.770	155.790	167.9	"	"
17	4	CERRO GORDO (MASON CITY)	37.16	155.190	155.610	192.8	154.890	155.685	127.3	"	"
18	6	CHEROKEE (CHEROKEE)	37.16	155.070	155.580	146.2	154.770	155.790	127.3	"	"
19	10	CHICKASAW (NEW HAMPTON)	37.12	155.070	155.580	167.9	154.800	155.700	146.2/167.9	"	"
20	27	CLARKE (OSCEOLA)	37.14	155.010	155.535	127.3	154.770	155.790	127.3	"	"
21	2	CLAY (SPENCER)	37.14	154.830	155.310	146.2	154.770	155.790	127.3/192.8	"	"
22	5	CLAYTON (ELKADER)	37.24	155.010	155.535	167.9	154.800	155.700	192.8	"	"
23	17	CLINTON (CLINTON)	37.12	154.845	155.520	146.2	154.770	155.790	167.9	"	"
24	13	CRAWFORD (DENISON)	37.24	155.190	155.610	192.8	154.800	155.700	127.3	"	"
25	20	DALLAS (ADEL)	37.20	154.725	155.250	192.8	154.770	155.790	146.2	"	"
26	29	DAVIS (BLOOMFIELD)	37.20	155.010	155.535	146.2	154.800	155.700	167.9	"	"
27	27	DECATUR (LEON)	37.14	155.010	155.535	127.3	154.770	155.790	127.3	"	"
28	12	DELAWARE (MANCHESTER)	37.20	154.830	155.310	192.8	154.800	155.700	127.3	"	"
29	30	DES MOINES (BURLINGTON)	37.14	155.070	155.580	146.2	154.800	155.700	127.3	"	"
30	2	DICKENSON (SPIRIT LAKE)	37.14	154.830	155.310	146.2	154.770	155.790	192.8	"	"
31	12	DUBUQUE (DUBUQUE)	37.20	154.830	155.310	192.8	154.770	155.790	167.9	"	"
32	2	EMMET (ESTERVILLE)	37.14	154.830	155.310	146.2	154.770	155.790	192.8		
33	11	FAYETTE (WEST UNION)	37.08	154.845	155.520	127.3	154.800	155.700	146.2/192.8	155.910	155.850
34	4	FLOYD (CHARLES CITY)	37.16	155.190	155.610	192.8	154.800	155.700	146.2/167.9	"	"
35	9	FRANKLIN (HAMPTON)	37.20	154.725	155.250	127.3	154.890	155.685	127.3	"	"

NOTE: All Tx and Rx frequencies are in megahertz (MHz)

*This frequency (2 required on occasion) is subject to some modification depending upon IHPR planning.

COUNTY	REG	COUNTY (CO. SEAT)	BASE STATION TX/RX LOW-BAND OPERATIONS	BASE STATION TX/RX HIGH-BAND OPERATIONS	BASE STATION TX HIGH-BAND INFORMATION	BASE STATION CTCS FREQUENCY Hz	MOBILE TX WIDE AREA MOBILE	MOBILE RX WIDE AREA MOBILE	MOBILE WIDE AREA CTCS Hz	MOBILE INFORMATION MOBILE	PORTABLE TX
36	18	FREMONT (SIDNEY)	37.24	155.190	155.610	167.9	154.890	155.685	192.8	155.910	155.850
37	13	GREENE (JEFFERSON)	37.24	155.190	155.610	192.8	154.800	155.700	192.8	"	"
38	10	GRUNDY (GRUNDY CENTER)	37.12	155.070	155.580	167.9	154.800	155.700	146.2	"	"
39	19	GUTHRIE (GUTHRIE CENTER)	37.12	154.845	155.520	146.2	154.800	155.700	192.8	"	"
40	8	HAMILTON (WEBSTER CITY)	37.08	154.845	155.520	146.2	154.890	155.685	146.2	"	"
41	3	HANCOCK (GARNER)	37.24	155.010	155.535	127.3	154.890	155.685	127.3	"	"
42	9	HARDIN (ELDORA)	37.20	154.725	155.250	127.3	154.890	155.685	146.2	"	"
43	18	HARRISON (LOGAN)	37.08	154.830	155.310	167.9	154.800	155.700	146.2	"	"
44	30	HENRY (MT. PLEASANT)	37.14	155.070	155.580	146.2	154.800	155.700	167.9	"	"
45	5	HOWARD (CRESCO)	37.24	155.010	155.535	167.9	154.800	155.700	167.9	155.850	155.970/156.03
46	8	HUMBOLDT (DAKOTA CITY)	37.08	154.845	155.520	146.2	154.890	155.685	127.3	155.910	155.850
47	6	IDA (IDA GROVE)	37.16	155.070	155.580	146.2	154.770	155.790	127.3	"	"
48	24	IOWA (MARENGO)	37.08	154.725	155.250	167.9	154.890	155.685	167.9/192.8	"	"
49	12	JACKSON (MAQUOKETA)	37.20	154.830	155.310	192.8	154.770	155.790	167.9	"	"
50	23	JASPER (NEWTON)	37.12	154.845	155.520	192.8	154.770	155.790	146.2	"	"
51	29	JEFFERSON (FAIRFIELD)	37.20	155.010	155.535	146.2	154.800	155.700	167.9	"	"
52	24	JOHNSON (IOWA CITY)	37.08	154.725	155.250	167.9	154.890	155.685	167.9	"	"
53	16	JONES (ANAMOSA)	37.14	155.190	155.610	192.8	154.770	155.790	167.9	"	"
54	29	KEOKUK (SIGOURNEY)	37.20	155.010	155.535	146.2	154.800	155.700	167.9	"	"
55	3	KOSSUTH (ALGONA)	37.24	155.010	155.535	127.3	154.890	155.685	127.3	155.910	155.910 or 155.97/156.
56	31	LEE (FORT MADISON)	37.12	155.190	155.610	127.3	154.800	155.700	127.3/167.9	"	155.850
57	16	LINN (CEDAR RAPIDS)	37.14	155.190	155.610	192.8	154.890	155.685	167.9	"	"
58	25	LOUISA (WAPELLO)	37.24	154.830	155.310	127.3	154.800	155.700	127.3/167.9	"	"
59	28	LUCAS (CHARITON)	37.24	154.830	155.310	167.9	154.770	155.790	127.3	"	"
60	1	LYON (ROCK RAPIDS)	37.12	155.190	155.610	127.3	154.770	155.790	167.9	"	"
61	20	MADISON (WINTERSET)	37.20	154.725	155.250	192.8	154.770	155.790	146.2	"	"
62	29	MAHASKA (OSKALOOSA)	37.20	155.010	155.535	146.2	154.800	155.700	146.2	"	"
63	22	MARION (KNOXVILLE)	37.08	155.190	155.610	146.2	154.770	155.790	146.2	"	"
64	15	MARSHALL (MARSHALLTOWN)	37.24	154.830	155.310	146.2	154.770	155.790	146.2	"	"
65	18	MILLS (GLENWOOD)	37.24	155.190	155.610	167.9	154.890	155.685	192.8	"	"
66	4	MITCHELL (OSAGE)	37.16	155.190	155.610	192.8	154.800	155.700	167.9	155.850	155.970/156.03
67	6	MONONA (ONAWA)	37.16	155.070	155.580	146.2	154.800	155.700	146.2	155.910	155.850
68	28	MONROE (ALBIA)	37.24	154.830	155.310	167.9	154.800	155.700	146.2	"	"
69	18	MONTGOMERY (RED OAK)	37.24	155.190	155.610	167.9	154.890	155.685	146.2	"	"
70	25	MUSCATINE (MUSCATINE)	37.24	154.830	155.310	127.3	154.770	155.790	127.3	"	"
71	1	O'BRIEN (PRIMGHAR)	37.12	155.190	155.610	127.3	154.770	155.790	127.3/167.9	155.910	155.850
72	1	OSCEOLA (SIBLEY)	37.12	155.190	155.610	127.3	154.770	155.790	167.9	"	"
73	18	PAGE (CLARINDA)	37.24	155.190	155.610	167.9	154.890	155.685	127.3	"	"
74	2	PALO ALTO (EMMETSBURG)	37.14	154.830	155.310	146.2	154.770	155.790	127.3/192.8	"	"
75	6	PLYMOUTH (LE MARS)	37.16	155.070	155.580	146.2	154.770	155.790	146.2	"	"
76	7	POCAHONTAS (POCAHONTAS)	37.20	154.725	155.250	167.9	154.770	155.790	127.3	"	"
77	21	POLK (DES MOINES)	37.16	155.070	155.580	167.9	154.770	155.790	146.2	"	"
78	18	POTTAWATTAMIE (COUNCIL BLUFFS)	37.08	154.830	155.310	167.9	154.890	155.685	146.2/192.8	"	"
79	23	POWESHIEK (MONTEZUMA)	37.12	154.845	155.520	192.8	154.890	155.685	192.8	"	"
80	27	RINGGOLD (MT. AYR)	37.14	155.010	155.535	127.3	154.770	155.790	127.3	"	"

NOTE: All Tx and Rx frequencies are in megahertz (MHz)

Table 2-1 page 3 CHANNEL AND CTCS FREQUENCIES

COUNTY	REG	COUNTY (CO.SEAT)	BASE STATION TX/RX LOW-BAND OPERATIONS	BASE STATION TX/RX HIGH-BAND OPERATIONS	BASE STATION TX HIGH-BAND INFORMATION	BASE STATION CTCS FREQUENCY Hz	MOBILE TX WIDE AREA MOBILE	MOBILE RX WIDE AREA MOBILE	MOBILE WIDE AREA CTCS Hz	MOBILE INFORMATION MOBILE	PORTABLE TX
81	7	SAC (SAC CITY)	37.20	154.725	155.250	167.9	154.770	155.790	127.3	155.910	155.850
82	26	SCOTT (DAVENPORT)	37.16	155.070	155.580	127.3	154.770	155.790	167.9	"	"
83	18	SHELBY (HARLAN)	37.08	154.830	155.310	167.9	154.800	155.700	127.3	"	"
84	1	SIOUX (ORANGE CITY)	37.12	155.190	155.610	127.3	154.770	155.790	146.2/167.9	"	"
85	14	STORY (NEVADA)	37.14	155.010	155.535	167.9	154.770	155.790	146.2	"	"
86	15	TAMA (TOLEDO)	37.24	154.830	155.310	146.2	154.890	155.685	167.9/192.8	"	"
87	27	TAYLOR (BEDFORD)	37.14	155.010	155.535	127.3	154.890	155.685	127.3	"	"
88	27	UNION (CRESTON)	37.14	155.010	155.535	127.3	154.770	155.790	127.3	"	"
89	29	VAN BUREN (KEOSAUQUA)	37.20	155.010	155.535	146.2	154.800	155.700	167.9	"	"
90	29	WAPELLO (OTTUMWA)	37.20	155.010	155.535	146.2	154.800	155.700	167.9	"	"
91	22	WARREN (INDIANOLA)	37.08	155.190	155.610	146.2	154.770	155.790	146.2	"	"
92	24	WASHINGTON (WASHINGTON)	37.08	154.725	155.250	167.9	154.800	155.700	167.9	"	"
93	28	WAYNE (CORYDON)	37.24	154.830	155.310	167.9	154.770	155.790	127.3	"	"
94	8	WEBSTER (FT. DODGE)	37.08	154.845	155.520	146.2	154.890	155.685	146.2	"	"
95	3	WINNEBAGO (FOREST CITY)	37.24	155.010	155.535	127.3	154.890	155.685	127.3	"	"
96	5	WINNESHIEK (DECORAH)	37.24	155.010	155.535	167.9	154.800	155.700	167.9	"	"
97	6	WOODBURY (SIOUX CITY)	37.16	155.070	155.580	146.2	154.770	155.790	127.3/146.2	"	"
98	4	WORTH (NORTHWOOD)	37.16	155.190	155.610	192.8	154.890	155.685	127.3	"	"
99	8	WRIGHT (CLARION)	37.08	154.845	155.520	146.2	154.890	155.685	127.3	"	"

NOTE: All Tx and Tx frequencies are in megahertz (MHz)

TABLE 2-2 TACTICAL/INFORMATION/ POINT-TO-POINT (TIP) CHANNELS
BASE STATION RADIO SYSTEM- EQUIPMENT LISTS

Function - Provides the state-wide Tactical (155.475 MHz) channel (monitor primarily, transmit only when necessary) and county-wide Information Channel, for base-to-mobile/mobile-to-base communications. In addition the Point-To-Point Channel (155.370 MHz) may be implemented on the same transmitter.

Hardware Required -		Spec. Ident.
Qty.	Description	
1 -	High-band base transmitter, 100 watt, 4- frequency capability.	E-2
	High-band receivers:	
1-	Tactical Channel	F
1-	Information Channel (Mobile transmit)	F-1
1-	Information Channel (Base Transmitter monitor)*	F
1-	Point-To-Point Channel*	F
1-	Portable (Transmit) Channel	F-1
1-	Antenna Tower (as required)	T
1-	Antenna	D-4 thru D-7
1-	Antenna coupler, 4-port	G
1-	Control console modifications/additions	U
** N-	Tactical mobile-transceivers (4-frequency)	M

Note: *These receivers will be tied together on one part of this multi-coupler. This will reduce the sensitivity of both receivers by 3 dB, however, the system performance is not critical in these receivers.

** N represents an unknown quantity which will be completed for each specific agency.

TABLE 2-3 COMM CENTER EQUIPMENT LISTS

Function - Provides the centralized control for communication subsystems plus ancillary facilities for dispatcher personnel.

		Hardware Required -	Spec. Ident.
	1-	TRACIS Terminal	N/A
	1-	Multi-channel audio recorder	O
*	N-	Control consoles (items not covered prev.)	U
	1-	Telephone system	N/A
	1-	Emergency power source	R
	1-	Secure Room	N/A
*	N-	Phone Patch	X
*	N-	Voice privacy base station unit (option)	W
*	N-	Intrusion alarm panel	N/A
	1-	Personal Portable battery charger (when high-band portables are employed)	Y
	N-	Call Diverter (See Section 2.2.6)	AC

FIGURE 2-2 SYSTEM CONFIGURATION LOW POPULATION COUNTIES

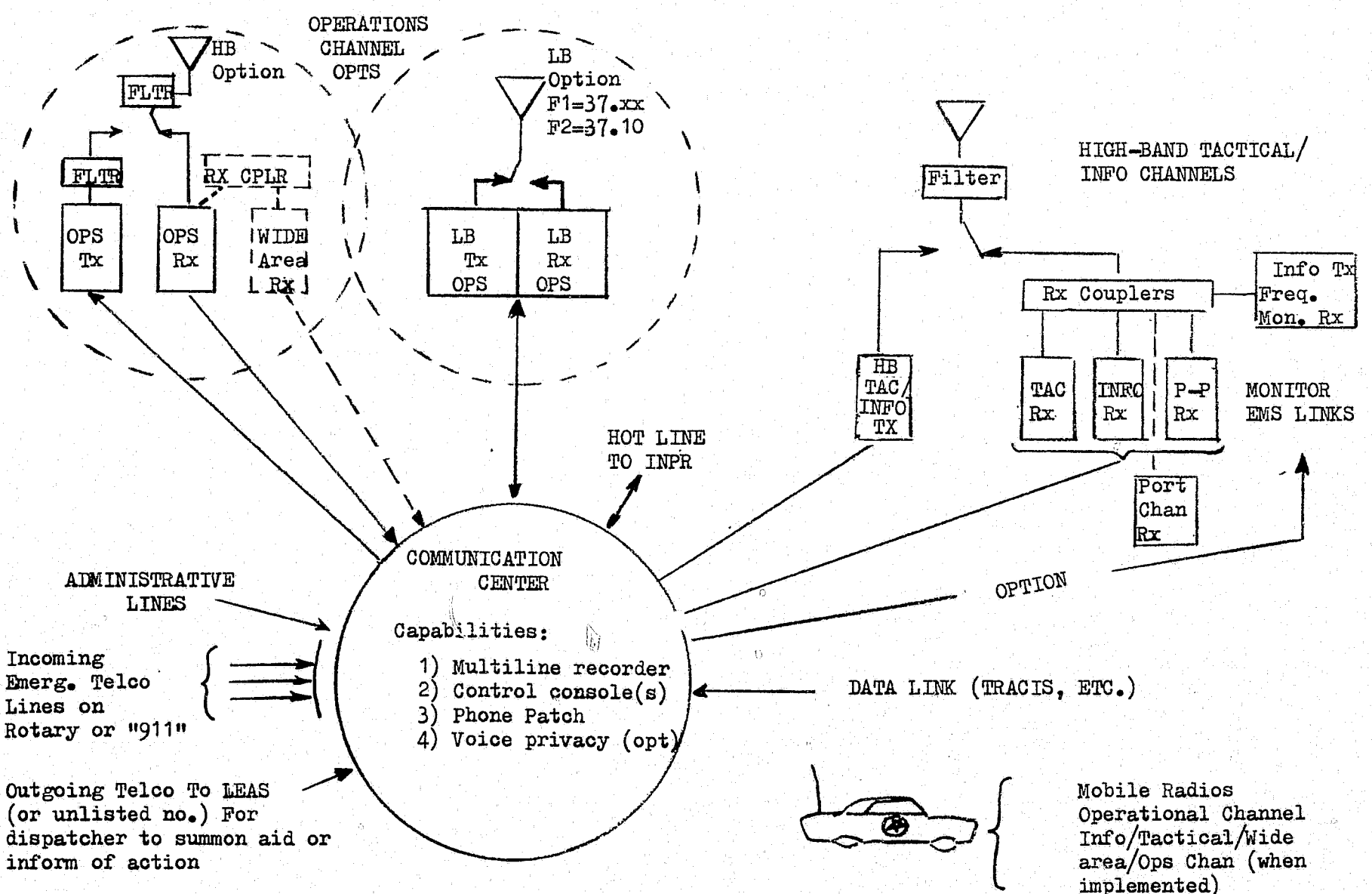
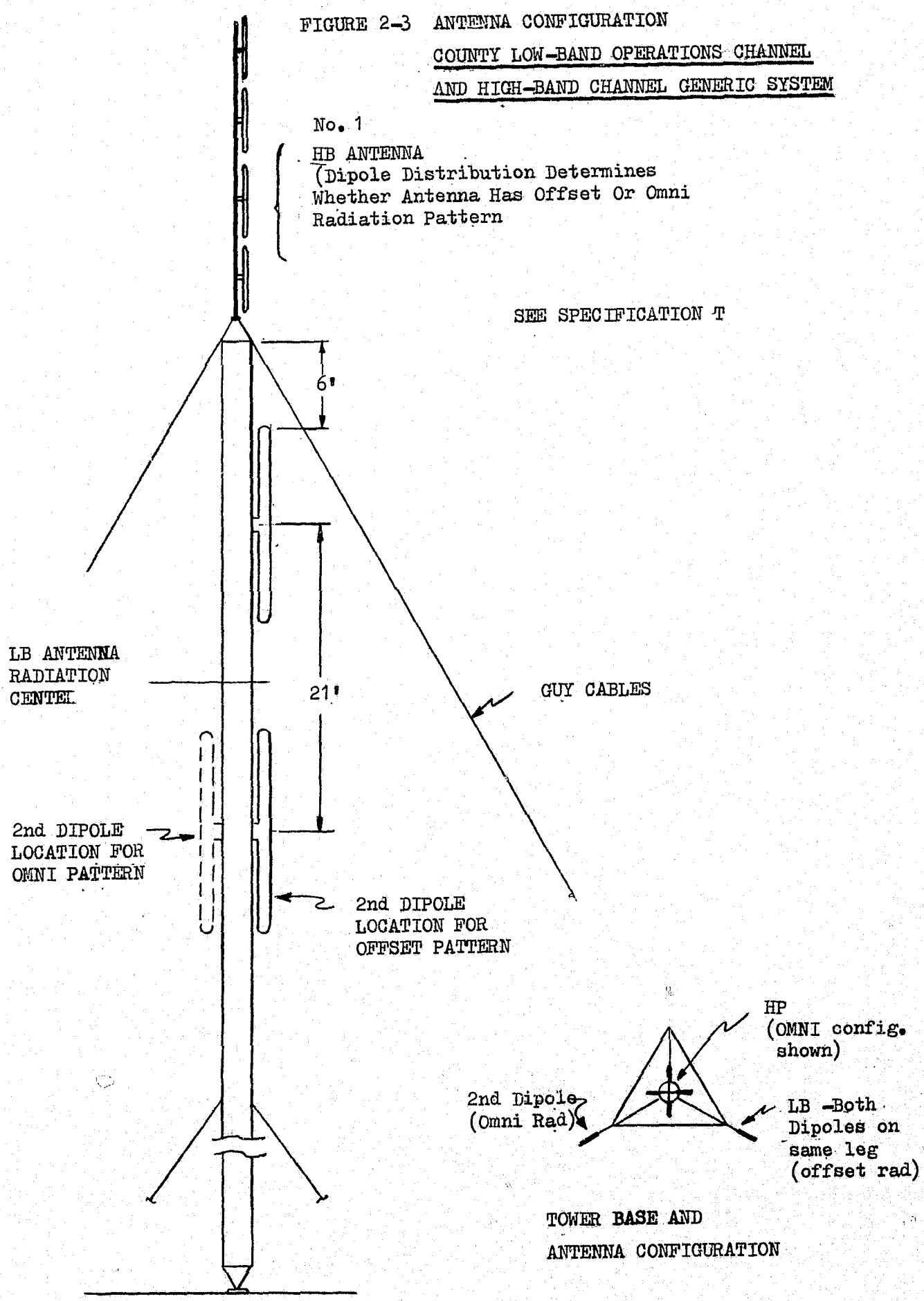


FIGURE 2-3 ANTENNA CONFIGURATION
COUNTY LOW-BAND OPERATIONS CHANNEL
AND HIGH-BAND CHANNEL GENERIC SYSTEM



TOWER BASE AND
ANTENNA CONFIGURATION

Table 2-4 COUNTY COMMUNICATIONS SYSTEM - GENERIC TYPE & SPECIFIC ANTENNA INFORMATION

* Orientation

Co. No. & FREQ REGION	COUNTY (CO. SEAT)	ANTENNA LOCATION (NAME)	ANT LATITUDE	ANT LONGITUDE	TOWER BASE MSL	TOWER HEIGHT FEET new*	RAD. CENTER HB #1 ANT	RAD. CENTER HB #2 or LB ANT	ANT TYPE LB SPEC IDENT.	ANT TYPE HB #1 SPEC IDENT. **	ANT TYPE HB #2 SPEC IDENT. **	GENERIC TYPE
1 19	ADAIR (GREENFIELD)	no change	no change	no change	1375	95	105	75	D-8	D-4	D-4a NE/SW	1A or B
2 27	ADAMS (CORNING)	"	"	"	1136	150*	160	130	"	D-4	D-4a NE/SW	"
3 5	ALLAMAKEE (WAUKON)	"	"	"	1035	133	143	110	"	D-4	D-5a E	"
4 28	APPANOOSE (CENTERVILLE)	"	"	"	1008	91	100	70	"	D-4	D-4a E/W	"
5 19	AUDUBON (AUDUBON)	2 mi. NNE Audubon	41 44 20	94 55 30	1450	100*	110	80	"	D-4	D-4a SE/NW	"
6 16	BENTON (VINTON)	no change	no change	no change	840	105	115	85	D-8a S	D-5 S	D-5a SW	"
7 10	BLACKHAWK (WATERLOO)	"	"	"	870	160WT	170	140	D-8	D-4	D-4a SW/NE	4A
8 14	BOONE (BOONE)	"	"	"	1140	90	100	70	D-8	D-4	D-4a NW/SE	1A or B
9 10	BREMER (WAVERLY)	"	"	"	940	169	170	140	D-8a SE	D-5a SE	D-5a SE	"
10 11	BUCHANAN (INDEPENDENCE)	"	"	"	950	150	160	130	D-8	D-4	D-4a N/S	"
11 7	BUENA VISTA (STORM LAKE)	"	"	"	1487	100	110	80	D-8a NE	D-5 NE	D-5a NE	"
12 10	BUTLER (ALLISON)	"	"	"	1040	80*	90	60	D-8	D-4	D-5b N/S	"
13 7	CALHOUN (ROCKWELL CITY)	"	"	"	1232	90	100	70	"	D-4	D-5b SW/NE	"
14 13	CARROLL (CARROLL)	"	"	"	1290	150*	160	140	"	D-4	D-5b NW/SE	"
15 19	CASS (ATLANTIC)	"	"	"	1209	265TTH	160	130	D-8a SE	D-4a SE	D-4a SE	"
16 24	CEDAR (TIPTON)	"	"	"	849	152TTH	90	60	D-8	D-4a	D-4a NW/SE	"
17 4	CERRO GORDO (MASON CITY)	"	"	"	1183	160	170	140	"	D-4	D-5b NW/SE	2C or D
18 6	CHEROKEE (CHEROKEE)	"	"	"	1350	120*	130	100	"	D-4	D-5b SW/NE	1A or B
19 10	CHICKASAW (NEW HAMPTON)	"	"	"	1180	130*	140	110	"	D-4	D-5b SW/NE	"
20 27	CLARKE (OSCEOLA)	"	"	"	1139	140	90	60	"	D-4a	D-4a NW/SE	"
21 2	CLAY (SPENCER)	"	"	"	1335	125*	135	105	"	D-4	D-5b SW/NE	"
22 5	CLAYTON (ELKADER)	"	"	"	1180	140	150	120	"	D-4	D-5b N/S	"
23 17	CLINTON (CLINTON)	"	"	"	750	300*	310	280	D-8a W	D-5 W	D-5a W	2C or D
24 13	CRAWFORD (DENISON)	1 mi. N of Denison	42 00 50	95 20 20	1400	100*	110	80	D-8	D-4	D-5b NW/SE	1A or B
25 20	DALLAS (ADEL)	no change	no change	no change	935	125WT	135	105	D-9	D-4	D-5b NW/SE	"
26 29	DAVIS (BLOOMFIELD)	"	"	"	850	120	130	100	D-8	D-4	D-5b SW/NE	"
27 27	DECATOR (LEON)	"	"	"	1124	155WT	110	80	D-9	D-4a	D-4a SW/NE	"
28 12	DELAWARE (MANCHESTER)	"	"	"	970	188	198	168	D-8	D-4	D-5b N/S	"
29 30	DES MOINES (BURLINGTON)	"	"	"	702	118WT	130	100	D-9	D-4	D-4a SW/NE	2C or D
30 2	DICKENSON (SPIRIT LAKE)	"	"	"	1450	100*	110	80	D-8	D-4	D-5b SW/NE	1A or B
31 12	DUBUQUE (DUBUQUE)	2 mi. E of Peosta	42 27 15	90 49 20	1095	100*	110	80	"	D-5	D-5b N/S	4A
32 2	EMMET (ESTHERVILLE)	no change	no change	no change	1320	150	140	120	D-8a E	D-5b E	D-5b E	1A or B
33 11	FAYETTE (WEST UNION)	"	"	"	1188	148WT	158	128	D-8a S	D-5 S	D-5b S	"
34 4	FLOYD (CHARLES CITY)	"	"	"	1026	150WT	160	130	D-8	D-4	D-4a SW/NE	"
35 9	FRANKLIN (HAMPTON)	"	"	"	1145	130	140	110	D-8	D-4	D-5b SW/NE	"

** Antenna Orientation - On the tower side-mount antennas on HB#2, the gain maximizes bi-directionally with respect to the tower apex direction. The directions (compass) indicated are those corresponding to the bi-directionally. On existing towers, this implies selecting the apex closest to that which will give the desired directivity. On new towers, the apexes should be optionally aligned before the tower base is fixed. The direction away from the antenna (minimum gain direction) should be that to the closest county boundary or corner depending whether the bi-directionality is N-S, E-W or diagonal (SW-NE, NW-SE).

Legend: TTH = Tower Too High
WT = Water Tower
* New Tower Required

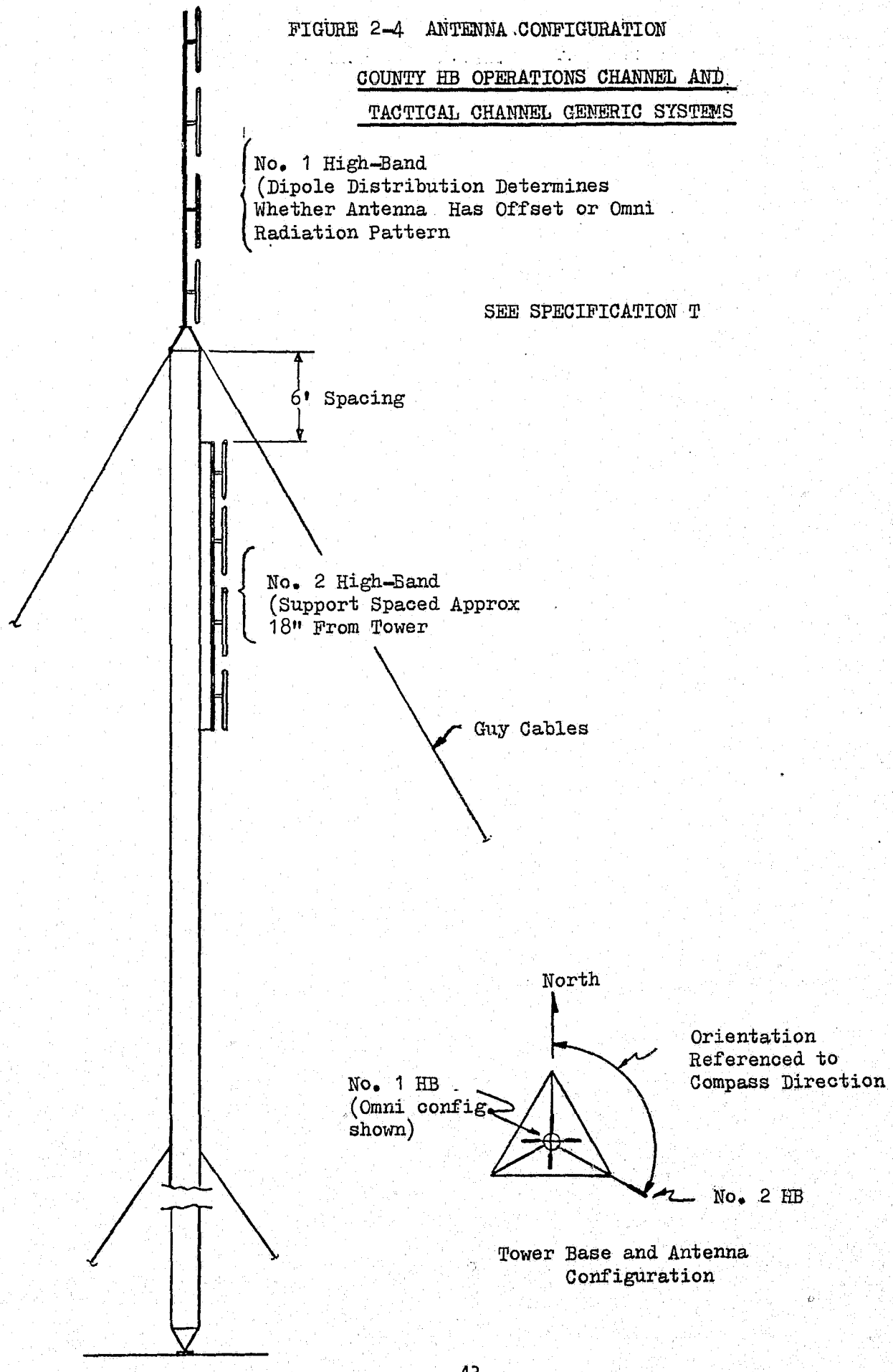
Table 2-4

Co. No. & FREQ REGION	COUNTY (CO. SEAT)	ANTENNA LOCATION (NAME)	ANT LATITUDE	ANT LONGITUDE	TOWER BASE MSL	TOWER HEIGHT FEET new*	RAD. CENTER HB #1 ANT	RAD. CENTER HB #2 or LB ANT	ANT TYPE LB SPEC IDENT	ANT TYPE HB #1 SPEC IDENT	ANT TYPE HB #2 SPEC IDENT	GENERIC TYPE
36 32	FREMONT (SIDNEY)	no change	no change	no change	1125	80	90	60	D-8	D-4	D-4a SW/NE	1A or B
37 13	GREENE (JEFFERSON)	"	"	"	1165	125	90	60	D-8	D-4	D-4a SW/NE	"
38 10	GRUNDY (GRUNDY CENTER)	"	"	"	978	120*	130	100	"	D-4	D-4a SW/NE	"
39 19	GUTHRIE (GUTHRIE CENTER)	"	"	"	1200	93	103	73	"	D-4	D-4a N/S	"
40 8	HAMILTON (WEBSTER CITY)	"	"	"	1085	120	130	100	D-8a SE	D-5 SE	D-5b SE	"
41 3	HANCOCK (GARNER)	"	"	"	1230	95	105	75	D-8a W	D-5 W	D-5b W	"
42 9	HARDIN (ELDORA)	Mar St US 65 & IA67	42 23 00	93 14 45	1100	80*	90	60	D-8	D-4	D-4a NW/SE	"
43 18	HARRISON (LOGAN)	no change	no change	no change	1000	170 WT	180	150	D-9	D-4	D-4a NW/SE	"
44 30	HENRY (MT. PLEASANT)	"	"	"	718	120*	130	100	D-8	D-4	D-4a NW/SE	"
45 5	HOWARD (CRESCO)	"	"	"	1280	120	130	100	D-8a W	D-5 W	D-5b W	"
46 8	HUMBOLDT (DAKOTA CITY)	"	"	"	1097	80	90	60	D-8	D-4	D-4a E-W	"
47 6	IDA (IDA GROVE)	Ida Grove	42 22 20	95 28 50	1445	80*	90	60	D-8	D-4	D-4a NW/SE	"
48 24	IOWA (MARENGO)	no change	no change	no change	800	150*	160	130	D-8a S	D-5 S	D-5b S	"
49 12	JACKSON (MAQUOKETA)	"	"	"	740	137 WT	147	127	D-9	D-4	D-4a NW/SE	"
50 23	JASPER (NEWTON)	"	"	"	946	147 WT	90	70	D-9	D-4	D-4a E-W	"
51 29	JEFFERSON (FAIRFIELD)	"	"	"	778	100	110	80	D-8	D-4	D-4a E-W	"
52 24	JOHNSON (IOWA CITY)	"	"	"	660	190	200	170	D-8	D-4	D-4a SW/NE	2C or D
53 16	JONES (ANAMOSA)	"	"	"	900	110 WT	120	90	D-8A E	D-5 E	D-5b E	1A or B
54 29	KEOKUK (SIGOURNEY)	"	"	"	795	125	135	105	D-8	D-4	D-4a N-S	"
55 3	KOSSUTH (ALGONA)	"	"	"	1219	250*	260	230	D-8	D-	D-5a N	"
56 31	LEE (FORT MADISON)	2.5 mi NE Ft. Madison	40 39 30	91 18 00	722	150*	160	130	D-8	D-4	D-4a SW/NE	"
57 16	LINN (CEDAR RAPIDS)	no change	no change	no change	925	120 WT	130	100	D-8a NE	D-5 NE	D-5b NE	4A
58 25	LOUISA (WAPELLO)	6.5 mi NW Wapello	41 13 20	91 17 40	770	100*	110	80	D-8	D-4	D-4a NW/SE	1A or B
59 28	LUCAS (CHARITON)	no change	no change	no change	1000	125 TTH	90	60	D-8	D-4a	D-4a SW/NE	"
60 1	LYON (ROCK RAPIDS)	"	"	"	1350	145	155	125	D-8	D-4	D-4a NW/SE	"
61 20	MADISON (WINTERSET)	"	"	"	1125	120*	130	100	D-8	D-4	D-4a SW/NE	"
62 29	MAHASKA (OSKALOOSA)	"	"	"	820	90*	100	70	D-8	D-4	D-4a SW/NE	"
63 22	MARION (KNOXVILLE)	"	"	"	900	160 TTH	90	60	D-8	D-4	D-4a E-W	"
64 15	MARSHALL (MARSHALLTOWN)	"	"	"	938	148	158	128	D-8	D-4	D-4a N-S	2C or D
65 32	MILLS (GLENWOOD)	"	"	"	1125	120*	130	100	D-8a E	D-5 E	D-5b E	1A or B
66 4	MITCHELL (OSAGE)	"	"	"	1135	170 TTH	110	80	D-8a N	D-5 N	D-5b E	"
67 6	MONONA (ONAWA)	Turin/ Castana	42 03 00	95 57 20	1350	100*	110	80	D-8	D-4	D-4a NW/SE	"
68 28	MONROE (ALBIA)	N/C	N/C	N/C	950	75	85	55	D-8	D-4	D-4a NW/SE	"
69 32	MONTGOMERY (RED OAK)	"	"	"	1340	113 TTH	90	60	D-8	D-4a	D-4a E-W	"
70 25	MUSCATINE (MUSCATINE)	"	"	"	700	100	110	80	D-8	D-4	D-4a SW/NE	2C or D

Co. No. & FREQ. REGION	COUNTY (CO. SEAT)	ANTENNA LOCATION NAME	ANT LATITUDE	ANT LONGITUDE	TOWER BASE MSL	TOWER HEIGHT FEET new	RAD. CENTER HB #1 ANT	RAD. CENTER HB #2 or LB ANT.	ANT TYPE LB SPEC IDENT	ANT TYPE HB #1 SPEC IDENT	ANT TYPE HB #2 SPEC IDENT	GENERIC TYPE
71 1	O'BRIEN (PRIMGHAR)	no change	no change	no change	1500	85	95	65	D-8	D-4	D-4a N-S	1A or B
72 1	OSCEOLA (SIBLEY)	"	"	"	1525	108	118	88	D-8	D-4	D-4a SW/NE	"
73 32	PAGE (CLARINSA)	"	"	"	1050	175*	185	155	D-8a N	D-5 W	D-5a W	"
74 2	PALO ALTO (EMMETSBURG)	"	"	"	1250	90	100	70	D-8	D-4	D-4a NW/SE	"
75 6	PLYMOUTH (LE MARS)	"	"	"	1331	130	140	110	D-8	D-4	D-4a NW/SE	"
76 7	POCAHONTAS (POCAHONTAS)	"	"	"	1232	75	85	55	D-8	D-4	D-4a NW/SE	"
77 21	POLK (DES MOINES)	"	"	"	950	137WT	147	117	D-8	D-4	D-4a E-W	3A
78 18	POTAWATOMIE (COUNCIL BLUFFS)	"	"	"	1250	300*	310	280	D-8a NE	D-5 NE	D-5a NE	3A
79 23	POWESHIEK (MONTEZUMA)	"	"	"	990	83	93	63	D-8a N	D-5 N	D-5a N	1A or B
80 27	RINGGOLD (MOUNT AYR)	"	"	"	1235	80*	90	60	D-8	D-4	D-4a SW/NE	"
81 7	SAC (SAC CITY)	"	"	"	1275	130*	140	110	D-8	D-4	D-4a NW/SE	"
82 26	SCOTT (DAVENPORT)	Near Eldridge	41 38 30	90 34 40	753	100*	110	80	D-8	D-4	D-4a E-W	3A
83 18	SHELBY (HARLAN)	no change	no change	no change	1250	200*	210	180	D-8	D-4	D-4a NW/SE	1A or B
84 1	SIOUX (ORANGE CITY)	"	"	"	1375	150*	160	130	D-8a NW	D-5 NW	D-5a NW	"
85 14	STORY (NEVADA)	"	"	"	950	95	105	75	D-8	D-4	D-4a E-W	2A or B
86 15	TAMA (TOLEDO)	"	"	"	1008	120	130	100	D-8	D-4	D-4a E-W	1A or B
87 27	TAYLOR (BEDFORD)	"	"	"	1100	200*	210	180	D-8	D-4	D-4a E-W	"
88 27	UNION (CRESTON)	"	"	"	1350	80	90	60	D-8a E	D-5 E	D-4a E	"
89 29	VAN BUREN (KEOSAUQUA)	"	"	"	640	150*	160	130	D-8	D-4	D-4a E-W	"
90 29	WAPELLO (OTTUMWA)	"	"	"	700	185	195	165	D-8	D-4	D-4a SW/NE	2C or D
91 22	WARREN (INDIANOLA)	"	"	"	961	90	100	70	D-8	D-4	D-4a NW/SE	1A or B
92 24	WASHINGTON (WASHINGTON)	"	"	"	760	110	120	90	D-8	D-4	D-4a NW/SE	"
93 28	WAYNE (CORYDON)	"	"	"	1093	115WT	125	95	D-8	D-4	D-4a SW/NE	"
94 8	WEBSTER (FORT DODGE)	"	"	"	1113	200*	210	180	D-8	D-4	D-4a NW/SE	2C or D
95 3	WINNEBAGO (FOREST CITY)	"	"	"	1245	150*	160	130	D-8a N	D-5	D-5a E-W	1A or B
96 5	WINNESHIEK (DECORAH)	"	"	"	1050	165	175	145	D-8	D-4	D-4a N-S	"
97 6	WOODBURY (SIOUX CITY)	North Water Tow	42 32 37	96 23 36	1420	200*	190	160	D-8a SE	D-5a SE	D-5a SE	3A
98 4	WORTH (NORTHWOOD)	no change	no change	no change	1175	120*	130	100	D-8a S	D-5 S	D-4a S	1A or B
99 8	WRIGHT (CLARION)	"	"	"	1113	148TTH	90	60	D-8	D-4a	D-4a NW/SE	"

FIGURE 2-4 ANTENNA CONFIGURATION

COUNTY HB OPERATIONS CHANNEL AND TACTICAL CHANNEL GENERIC SYSTEMS



Tower Base and Antenna Configuration

TABLE 2-5 COUNTY-WIDE LOW-BAND OPERATIONS CHANNEL RADIO SUBSYSTEM

Function - Provides county-wide base-to-mobile/mobile-to-base operations communications from a centralized dispatch point. Frequencies are assigned in accord with Table 2-1 to minimize interference between stations.

	Hardware Required -	Spec. Ident.
1-	Low-band base transmitter recrystalled or new channel added.	See Table 2-1 Freq. plan
1-	Low-band base receiver recrystalled or new receiver added. Tone decode is added.	See Table 2-1 Freq. plan
** N-	Mobile units modified for new frequency and CTCS tone encode generator added.	See Table 2-1 Freq. plan
X-	Modifications to antenna, tower, emergency power, remote control (s) as required.	Antenna D-8 thru D-9

* As required

** To be completed by each specific agency to equip operational mobile vehicles of officers.

TABLE 2-6 HIGH-BAND OPERATIONS CHANNEL RADIO SUBSYTEM

Function - Provides county-wide base-to-mobile/mobile-to-base operations communications from a centralized dispatch point. Frequencies are assigned to minimize interference between stations as well as tone codes to reduce nuisance interference in the control consoles.

	Hardware Required -	Spec. Ident.
1-	High-band transmitter (county operation frequency)	E-1
1-	Notch filter (max attenuation on Tactical/ Point-To-Point receive frequencies)	H
1-	Supplementary Notch filter (max attenuation on the Information and portable transmission frequency	I
1-	Antenna	D-4 thru D-7
-	High-band receiver (county operation frequency)	F-1
1-	Tower (if existing tower inadequate)	T
1-	Control console modifications/additions	U
** N-	Personal portable 5w	Q

Note: A qty (1) notch filter spec J is required for insertion in the Tactical/Information/Point-To-Point Channel transmission line per Figure 2-1 to attenuate the Operations Channel transmitter noise.

TABLE 2-7 COMBINED COUNTY/CITY (20 to 50k pop) SYSTEM HARDWARE

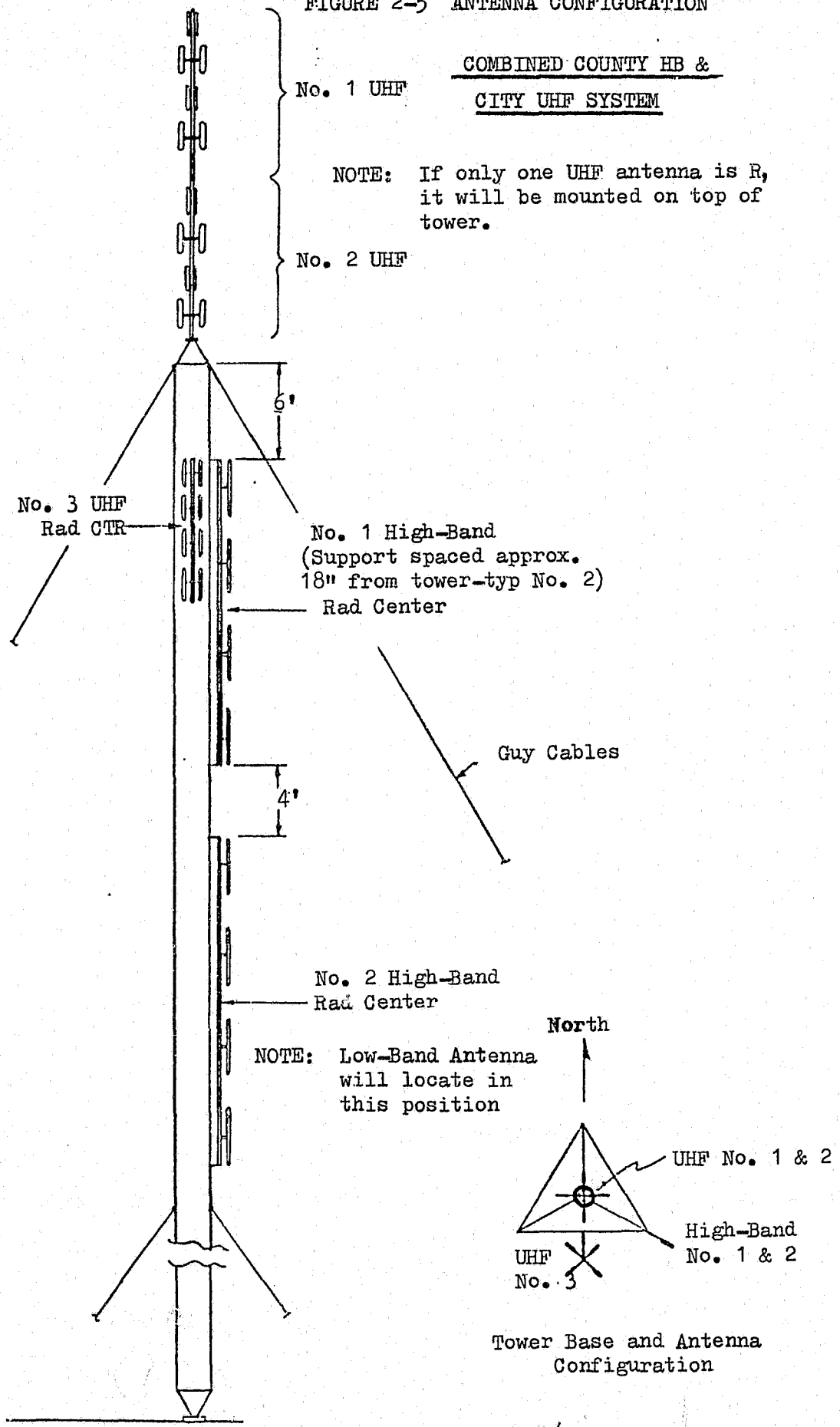
Radio Subsytem Hardware		Reference
1-	LB or HB county-wide Operations Channel system	Either Table 2-5 or 2-6
1-	HB county-wide Tactical/Info/Point-To-Point system	Table 2-2
1-	UHF Operations Channel system for county seat PD when population > 20 K	Table 2-11 & Table 2-10

** To be completed for each specific agency to equip comm and personnel.

	Communication Center Hardware Required	Spec. Ident.
1-	TRACIS Terminal	N/A
1-	Multi-channel Audio Receiver	O
1 or 2-	Control consoles (See Table 2-8)	U
1-	Telephone System (one instrument per control console)	
1-	Emergency Power Source	R
1-	Secure Room	N/A
1 or 2-	Phone Patch (one per control console)	X
N-	Voice Privacy Unit (Optional)	W
N-	Intrusion Alarm Panel	N/A
1-	Personal portable battery charger	V

FIGURE 2-5 ANTENNA CONFIGURATION

COMBINED COUNTY HB & CITY UHF SYSTEM



Tower Base and Antenna Configuration

P/O SPEC T

Mobile HB
TAC Radio

FIGURE 2-6 COMMUNICATION SYSTEM FUNCTIONS

COUNTIES WITH CITY POPULATION >20,000 <50,000

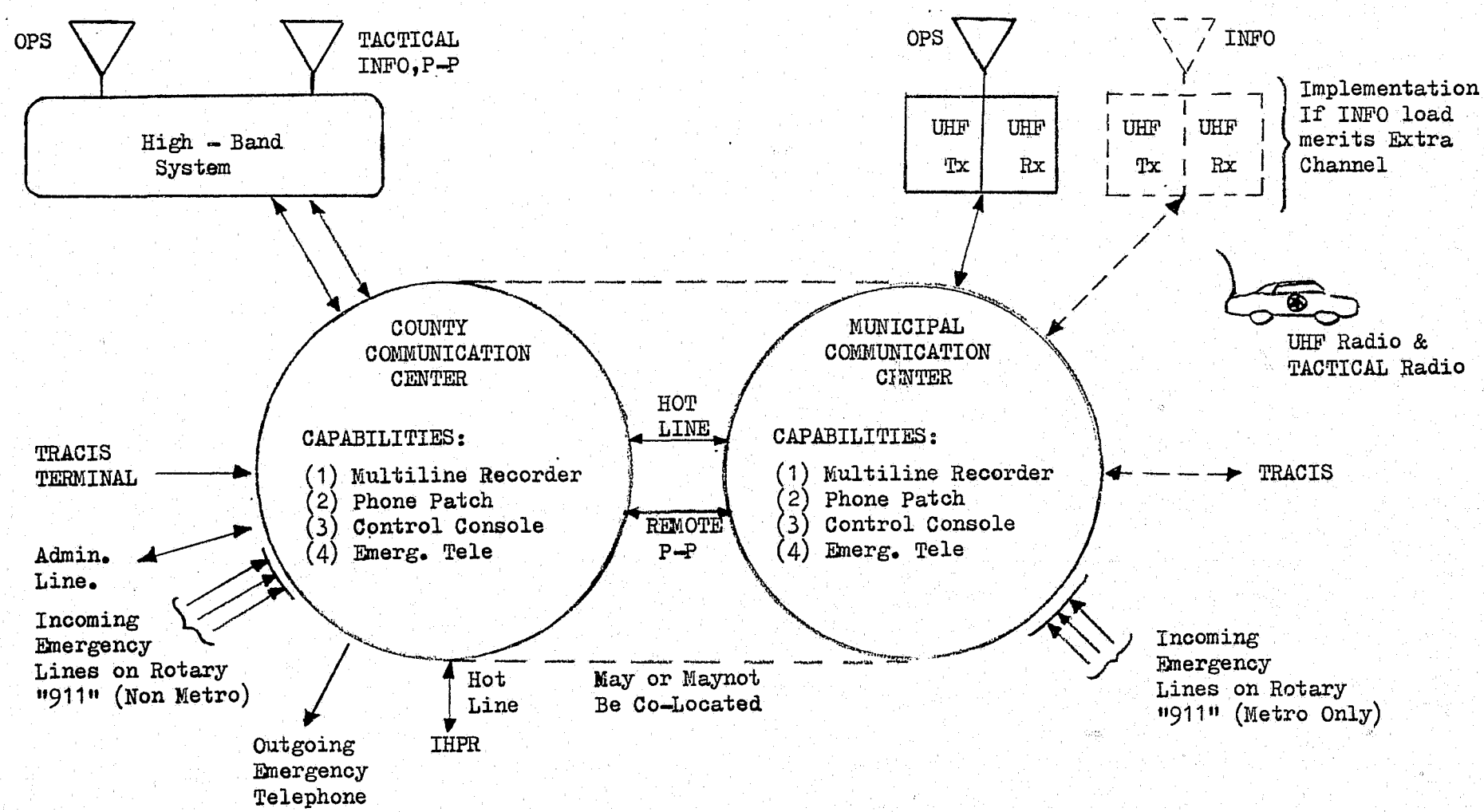


FIGURE 2-7 COMMUNICATIONS SYSTEMS FUNCTIONS

COUNTIES WITH CITY POPULATION >50,000

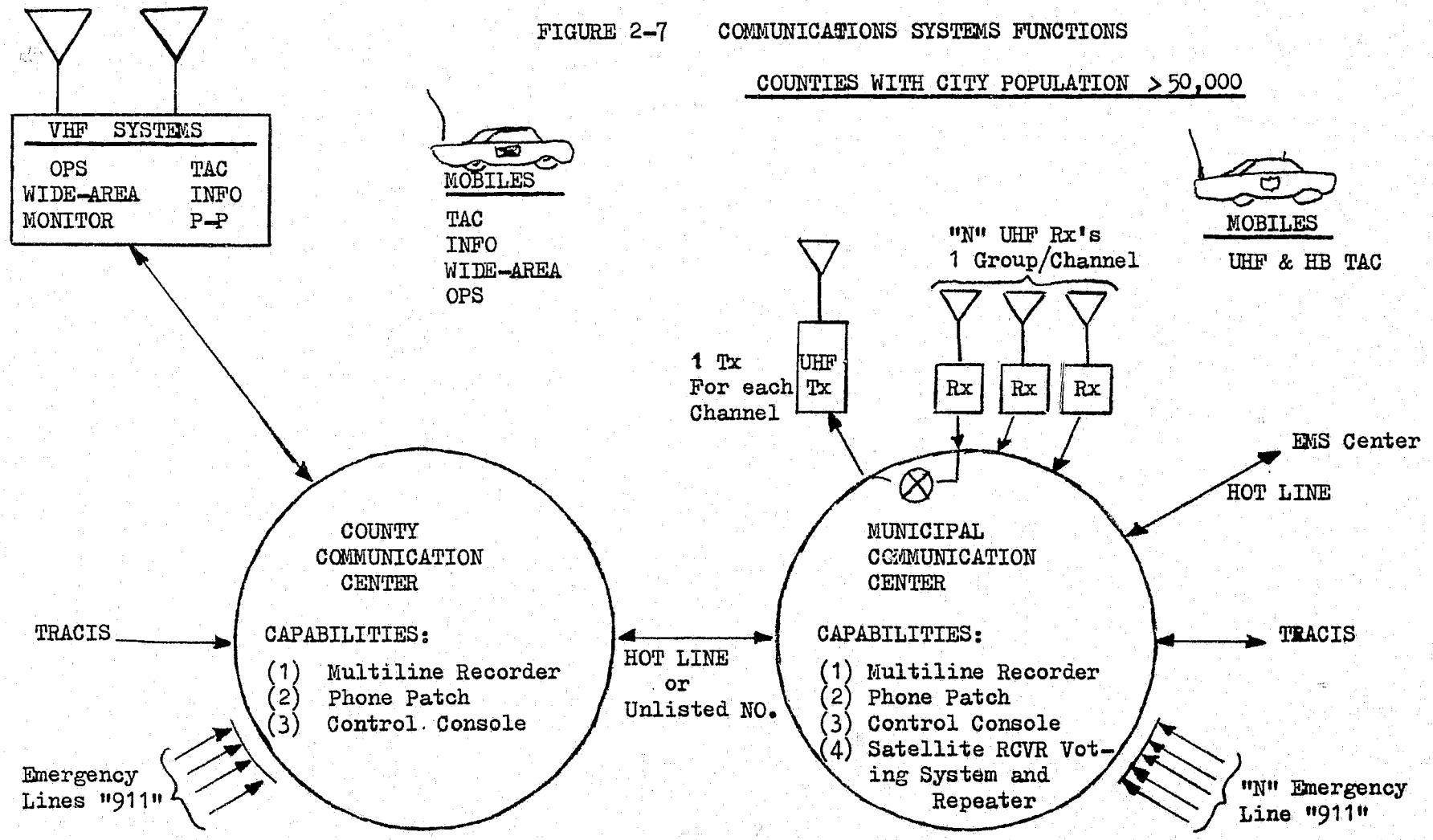


TABLE 2-8 COMM CENTER INFORMATION DETAIL

COMM CTR. LOCATION COUNTY. FREQ.	AREA	COMM CENTER DESIGNATION COUNTY - CITY	REQUIRED NUMBER OF OPERATIONS CHANNELS	REQUIRED NUMBER OF INFORMATIONS CHANNELS	RADIO DISPATCH POSITIONS #	EMERGENCY REQUEST TELEPHONE LINES #	OPERATORS COMBINED RADIO/TELE	OPERATORS TELE	MANNING REQUIRED PEAK SHIFT	MANNING REQUIRED DAILY STAFF	DISPATCH STAFF TOTAL
1	19	ADAIR	1	1	1	2	1		1	3	5
2	27	ADAMS	1	1	1	2	1		1	3	5
3	5	ALLAMAKEE	1	1	1	3	1		1	3	5
4	28	APPANOOSE	1	1	1	3	1		1	3	5
5	19	AUDUBON	1	1	1	2	1		1	3	5
6	16	BENTON	1	1	2	3	2		2	5	7
7	10	BLACKHAWK	1	1	2	4	2		2	5	7
7	10	WATERLOO	2	2	4	10	3	1	4	8	12
7	10	CEDAR FALLS	1		1	5	1	1	2	5	7
8	14	BOONE	1	1	2	3	2		2	5	7
9	10	BREMER	1	1	2	3	2		2	5	7
10	11	BUCHANAN	1	1	2	3	2		2	5	7
11	7	BUENA VISTA	1	1	2	3	2		2	4	6
12	10	BUTLER	1	1	2	3	2		2	4	6
13	7	CALHOUN	1	1	1	3	1		1	3	5
14	13	CARROLL	1	1	2	3	2		2	5	7
15	19	CASS	1	1	2	3	2		2	4	6
16	24	CEDAR	1	1	2	3	2		2	4	6
17	4	CERRO GORDO-MASON CITY	2	1	3	7	2	1	3	7	10
18	6	CHEROKEE	1	1	2	3	2		2	4	6
19	10	CHICKASAW	1	1	1	3	1		1	3	5
20	27	CLARKE	1	1	1	2	1		1	3	5
21	2	CLAY	1	1	2	3	2		2	4	6
22	5	CLAYTON	1	1	2	3	2		2	4	6
23	17	CLINTON-CLINTON	2	1	3	7	2	1	3	8	12
24	13	CRAWFORD	1	1	2	3	2		2	4	6
25	20	DALLAS	1	1	2	3	2		2	5	7
26	29	DAVIS	1	1	1	2	1		1	3	5
27	27	DECATUR	1	1	1	2	1		1	3	5
28	12	DELAWARE	1	1	2	3	2		2	4	6
29	30	DES MOINES-BURLINGTON	2	1	3	7	2	1	3	7	10
30	2	DICKINSON	1	1	1	3	1		1	3	5
31	12	DUBUQUE CO.	1	1	2	4	2		2	5	7
31	12	DUBUQUE CITY	2	1	4	11	3	1	4	1	12
32	2	EMMET	1	1	1	3	1		1	3	5
33	11	FAYETTE	1	1	2	4	2		2	5	7

COMM CTR LOCATION COUNTY FREQ	AREA	COMM CENTER DESIGNATION COUNTY - CITY	REQUIRED NUMBER OF OPERATIONS CHANNELS	INFORMATION CHANNELS	RADIO DISPATCH POSITIONS #	EMERGENCY TELEPHONE LINES #	OPERATORS COMBINED RADIO/TELE	TELE	MANNING REQUIRED PEAK SHIFT	DAILY STAFF	DISPATCH STAFF TOTAL
34	4	FLOYD	1	1	2	3	2		2	4	6
35	9	FRANKLIN	1	1	1	3	1		1	3	5
36	18	FREMONT	1	1	1	2	1		1	3	5
37	13	GREENE	1	1	1	3	1		1	3	5
38	10	GRUNDY	1	1	1	3	1		1	3	5
39	19	GUTHRIE	1	1	1	3	1		1	3	5
40	8	HAMILTON	1	1	2	3	2		2	4	6
41	3	HANCOCK	1	1	1	3	1		1	3	5
42	9	HARDIN	1	1	2	3	2		2	4	6
43	18	HARRISON	1	1	2	3	2		2	4	6
44	330	HENRY	1	1	2	3	2		2	4	6
45	5	HOWARD	1	1	1	3	1		1	3	5
46	8	HUMBOLDT	1	1	1	3	1		1	3	5
47	6	IDA	1	1	1	2	1		1	3	5
48	24	IOWA	1	1	2	3	2		2	4	6
49	12	JACKSON	1	1	2	3	2		2	4	6
50	23	JASPER	1	1	2	4	2		2	5	7
51	29	JEFFERSON	1	1	2	3	2		2	4	6
52	24	JOHNSON	1	1	2	3	2		2	5	6
52	24	IOWA CITY	1	1	3	6	2	1	3	6	9
53	16	JONES	1	1	2	3	2		2	4	6
54	29	KEOKUK	1	1	1	3	1		1	3	5
55	3	KOSSUTH	1	1	2	3	2		2	4	6
56	31	LEE	1	1	2	5	2		2	6	9
57	16	LINN	1	1	2	4	2		2	5	7
57	16	CEDAR RAPIDS	3	2	5	15	4	2	7	14	21
57	16	MARION	1		1	3	2		2	4	6
58	25	LOUISA	1	1	1	2	1		1	3	5
59	28	LUCAS	1	1	2	3	2		2	4	6
60	1	LYON	1	1	1	3	1		1	3	5
61	20	MADISON	1	1	1	3	1		1	3	5
62	29	MAHASKA	1	1	2	3	2		2	5	7
63	22	MARION	1	1	2	3	2		2	5	7
64	15	MARSHALL-MARSHALLTOWN	2	1	2	5	2		2	6	9
65	18	MILLS	1	1	2	3	2		2	5	7
66	4	MITCHELL	1	1	2	3	2		2	5	7
67	6	MONONA	1	1	2	3	2		2	4	6

Table 2-8 page 3

COMM CTR LOCATION COUNTY FREQ	AREA	COMM CENTER DESIGNATION COUNTY - CITY	REQUIRED NUMBER OF OPERATIONS CHANNELS	INFORMATION CHANNELS	RADIO DISPATCH POSITIONS #	EMERGENCY TELEPHONE LINES #	OPERATORS COMBINED RADIO/TELE	TELE	MANNING REQUIRED PEAK SHIFT	DAILY STAFF	DISPATCH STAFF TOTAL
68	28	MONROE	1	1	2	3	2		2	5	7
69	18	MONTGOMERY	1	1	1	2	1		1	3	5
70	25	MUSCATINE-MUSCATINE	2	1	2	4	2		2	5	7
71	1	O'BRIEN	1	1	2	3	2		2	4	6
72	1	OSCEOLA	1	1	1	2	1		1	3	5
73	18	PAGE	1	1	2	3	2		2	4	6
74	2	PALO ALTO	1	1	1	3	1		1	3	5
75	6	PLYMOUTH	1	1	2	3	2		2	4	6
76	7	POCAHONTAS	1	1	1	3	1		1	3	5
77	21	POLK	1	1	2	5	2		2	6	9
		DES MOINES	4	4	5	18	5	3	8	18	26
		W. DES MOINES (W HTS. CLIVE, URBANDALE)	1	1	2	6	2	1	3	6	9
78	18	POTTAWATTAMIE	1	1	2	4	2		2	5	7
		COUNCIL BLUFFS	2	1	3	9	3	1	4	9	13
79	23	POWESHIEK	1	1	2	3	2		2	4	6
80	27	RINGGOLD	1	1	1	2	1		1	3	5
81	7	SAC	1	1	2	3	2		2	4	6
82	26	SCOTT	1	1	2	3	2		2	5	7
82	26	DAVENPORT	2	2	4	12	3	2	5	11	17
82	26	BETTENDORF	1		2	5	2		2	4	6
83	18	SHELBY	1	1	2	3	2		2	4	6
84	1	SIOUX	1	1	2	4	2		2	5	7
85	14	STORY	1	1	2	3	2		2	5	7
	14	AMES	1		2	6	2	1	3	6	9
86	15	TAMA	1	1	2	3	2		2	4	6
87	27	TAYLOR	1	1	1	2	1		1	3	5
88	27	UNION	1	1	1	3	1		1	3	5
89	29	VAN BUREN	1	1	1	2	1		1	3	5
90	29	WAPELLO-OTTUMWA	2	1	2	4	2		2	5	7
91	22	WARREN	1	1	2	4	2		2	4	6
92	24	WASHINGTON	1	1	2	3	2		2	4	6
93	28	WAYNE	1	1	1	2	1		1	3	5
94	8	WEBSTER-FORT DODGE	2	1	2	6	2	1	3	6	9
95	3	WINNEBAGO	1	1	1	3	1		1	3	5
96	5	WINNESHIEK	1	1	2	3	2		2	5	7
97	6	WOODBURY	1	1	2	3	2		2	4	6
	6	SIOUX CITY	2	2	3	11	3	2	5	11	16
98	4	WORTH	1	1	1	2	1		1	3	5
99	8	WRIGHT	1	1	2	3	2		2	4	6

TABLE . 2-9 UHF FREQUENCY / CTCS PLAN

BASE STATION FREQUENCY MHz TRANSMIT	RECEIVE		CITY NAME (TONE CODE - Hz)
460.025	465.025	-	[Des Moines (203.5)], [Waterloo (141.3)]
460.050	465.050	-	Council Bluffs (C), Iowa City (B), [Waterloo (141.3)]
460.075	465.075	-	Burlington (B), Sioux City (B), West Des Moines (203.5)
460.100	465.100	-	Iowa City (B), Omaha (A), [Waterloo (141.3)]
460.125	465.125	-	[Davenport (156.7)], Fort Dodge (B)
460.150	465.150	-	[Davenport (156.7)], [Des Moines (203.5)], [Omaha (A)]
460.175	465.175	-	Cedar Rapids, (D), Muscatine (A), Sioux City (B)
460.200	465.200	-	Ames (C), Clinton (B)
460.225	465.225	-	Cedar Falls (141.3), [Des Moines (203.5)], [Omaha (A)]
460.250	465.250	-	Cedar Rapids (D)
460.275	465.275	-	Ankeny (203.5), [Omaha (A)]
460.300	465.300	-	Cedar Rapids (D), Sioux City (B)
460.325	465.325	-	[Carter Lake (C)], Council Bluffs (C), Marshalltown (B)
460.350	460.350	-	[Des Moines (203.5)]*
460.375	465.375	-	Bettendorf (156.8), Dubuque (D), [Mason City (B)]** [Omaha (A)], [Ottumwa (107.2)]
460.400	465.400	-	Cedar Rapids, (D), Council Bluffs (C), Sioux City (B) [Des Moines (203.5)], [Ottumwa (107.2)]
460.425	465.425	-	[Omaha (A)]
460.450	465.450	-	Dubuque (D), [Urbandale (203.5)], West Des Moines West Des Moines (203.5)
460.475	465.475	-	Cedar Rapids/Marion (D)
460.500	465.500	-	[Des Moines (203.5)]. [Omaha (A)]

NOTES:

(1) Frequencies in use are shown in brackets, as [Des Moines (203.5)] .

(2) Frequencies requested are shown underlined as Sioux City (B).

(3) * Des Moines now uses 460.325 / 465.325 MHz which due to IM produced should be changed to the 460.350 / 465.350 MHz as shown. If not changed then Marshalltown must use 460.350 / 465.350 MHz.

(4) ** Mason City now has the same tone code as Omaha, (A). This should change as shown to (B).

(5) Omaha frequencies are shown because of the impact on Iowa Plans.

(6) Tone Code Symbols:

A	127.3	Hz	These are from the EIA RS-220 "B" Group
B	146.2	Hz	
C	167.9	Hz	
D	192.8	Hz	

(7) Carter Lake tone code should be the same as Council Bluffs.

Table 2-10 CITIES - POPULATION OVER 20,000 - UHF SYSTEMS

Number Channels UHF Pairs	Municipality	Generic Type	Antenna Location	Lat.	Long.	Tower Base MSL	Tower Height Feet	Rad. Center of Antenna Feet	Ant. Type Spec. Id.	Transmitter Power Out-Put Watts	Number of Rx's	Remarks **
1	Ames	2C or D	PD	420152	933648	925	200	210	D-2	25	1	T1
1	Bettendorf	3B or C	High School	433145	903010	600	150	160	D-2	25	1	T1
1	Burlington	3C	Existing Site	404910	910751	698	150	160	D-2	25	2	T1
1	Cedar Falls	3B or C	PD	423212	922643	870	160	170	D-2	25	1	T1
1	Clinton	3C	Mt. Pleasant Park	415057	901215	700	110	120	D-2	25	1	T1
1	Fort Dodge	3C	Water tower	423026	940958	1113	130	140	D-2	25	1	T1
2	Iowa City (2 Chan)	3C	New Site	414015	913136	760	150	160	D-2	25	2	T1, T2
1	Mason City		Existing Site	430822	931200	1169	135	140	Existing	25	1	180 Watts authorised
1	Marshalltown	3C	Existing Site	420255	925447	935	150	160	D-2	25	1	T1
1	Muscatine	3C	Old Fire Station Existing Site	412508	910315	720	100	110	D-2	25	1	T1
1	Ottumwa		Existing	410104	922445	829	200	200	Existing			
3	Council Bluffs	3A	Memorial Park Cem. W.T.	411549	954929	1242	150	160	D-3	(qty2)25	2	T1, T2
			New Site Fairmont Park	411515	955043	1270	120	130	D-2	(qty1)25	1	T3
2	Davenport		Existing									
6	Des Moines		Existing									
3+1	Sioux City	3A	New Site North W.T.	423237	962336	1410	200	220	D-2 + D-3	(qty 3)100	3	Main remote base T1,T2,T3
			PD	422948	962445	1105	80	90	D-2	(qty 1) 25	3	Backup Base @PD T1/2
			Riverside	423100	962900	1110	80	90	D-2	-	2-3	Rx's only
			Morningside	424842	962020	1325	100	110	D-2	-	2-3	Rx's only
3	Waterloo	3A*	New Site East W.T.	423006	921900	870	150	160	D-3	(qty2)25	3	T1, T2
		(Existing)	New Site W.T. @ CEM	422832	922126	950	120	130	D-2	(qty1)25	3	T3
			W.W'loo W.T. on 218	423002	922213	925	100	110	D-2	-	3	
5	Cedar Rapids	3A	New Site Mt.Vernon Rd/ Memorial Drive	415833	913714	870	120	130	D-3	(qty2)25	5	Remote Base #1, T1 & T2
			New Site Glass Rd WT	420052	914045	920	120	130	D-3	(qty2)25	5	Remote Base #2, T3 & T4
			New Site Thomas Park	420136	913647	890	100	110	D-2	(qty1)25	5	Remote Base #3, T5
			Comm Engr. Tower	415700	914159	380	200	200	D-2a	-	5	Satellite Rx only
2	Dubuque	3A	City W.T	422954	904109	895	120	130	D-3	(qty2)25	2	T1 and T2
		3C	New Site Satellite	423135	903937	840	80	90	D-2	-	2	
2	W. Des Moines/ Urbandale (existing)		City W.T.	413455	934330	930	130	140	D-2	(qty 1) 25	2	Should have com- T1, T2
		"	City W.T.	413735	934535	968	100	123	D - 2	Existing(70)	2	bined Comm Center. T1

* Although it is an existing system, the system tabulated is revised to resolve propagation problems.

** Transmit frequencies at each site indicated by T1, T2, etc.
T 1/2 indicates multiple frequency transmitter.

TABLE 2-11 GENERIC III CITY UHF - OPERATIONS/INFORMATION CHANNEL RADIO SUBSYSTEM

Function - Provides the base-to-mobile/mobile-to-base Operations and Information Channel communications from a dispatch control center for a municipality or metropolitan area which may include surrounding smaller communities. The system will provide reliable communications for the law enforcement officer operating in a vehicle and when out of the vehicle. Systems have varying hardware quantities based on population.

2-11A. Hardware Required: 20,000 to 50,000 population (combined Operations and Information Channel) - Generic III-A

	Item Description	Spec. Ident.
1-	UHF transmitter, single frequency, 25w	A-1-25
N-	UHF receivers (satellite) (if required)*	B-1
1-	Receiver voting system (if required)	S
1-	Transmitting antenna tower	T
N-	Receiving antenna tower (s)	TBA
N-	Antenna	D-1 thru D-B
1-	Transmitter/Receiver duplexer	C

* - One receiver crystalled for the base transmit frequency when used for "talk around" purposes by mobiles or portables will be required for monitoring before transmitting to prevent disruption of priority communications in process.

TABLE 2-11 page 2

	Item Description	Spec. Ident.
N-	UHF mobile transceivers	N
or N-	UHF personal portables w/vehiclar mount	P-1 or P-2
N-	VHF Tactical transceivers	M

2-11 B. Hardware Required: (Over 50,000 population) (Separate Operations and Information Channels) Generic III B

	Item Description	Spec. Ident.
* N-	UHF transmitters single-frequency	A-1 (as required)
* N-	UHF receivers (satellite) **	B-1 (as required)
* N-	Receiver voting systems	S
* N-	Transmitting antenna towers	T
* N-	Satellite receiver antenna towers	TBA
* N-	Antenna	D-1 thru D-3
* N-	Transmitter/Receiver duplexers	C
* N-	Remote transmitter site emergency power suppliers.	R
* N-	Remote shelters (equipment enclosures) for satellite receivers	AA

* As required

** One receiver crystalled for the base transmit frequency when used for "talk around" purposes by mobiles and portables will be required for monitoring before transmitting to prevent disruption of priority communications in process.

TABLE 2-12a MOBILE HIGH BAND RADIO CHANNEL ASSIGNMENTS

F-1 OPTION I: High-Band Operations Channel - Transmit/Receive: Per Table 2-1

NOTE: (1) Use Mobile-to-Base
(2) Use Mobile-to-Mobile
(3) Use Aircraft unit-to-Mobile Unit

OPTION II: Mobile-to-Mobile-to-Portable
Transmit/Receive: Mobile Information Frequency.

NOTE: (1) Use when low-band Ops Channel is retained
(2) Allows Mobile-to-Aircraft Operations.
(3) Use No CTCS For Covert Operations

F-2 Information - Regional frequencies, Transmit Information Channel
Mobile Frequency Receive - Base Information Channel Frequency

NOTE: (1) See Table 2-1 for frequency assignments
(2) Use CTCS Regional Tone Encode

F-3 Wide-Area IHPR (LEA) Frequencies

NOTE: (1) Use Wide-Area CTCS Tone(s) encode assigned to county
(2) See Table 2-1 for frequency assignments

F-4 Tactical (Mutual-Aid) , Transmit/Receive: 155.475 MHz

NOTE: (1) No CTCS Tone Encode/Decode
(2) Aircraft Unit (Limited to Emergency only)

TABLE 2-12b PORTABLE RADIO HIGH-BAND CHANNEL ASSIGNMENTS

F-1 Portable-to-Base (all usage) - Transmit: Portable Frequency, See Notes 1,2,3
Receive : Regional Information Channel (Base) frequency (See Table 2-1)

NOTES: (1) See Table 2-1 for frequency assignments
(2) When satellite receivers are used in base station subsystems, they will receive this frequency
(3) Use CTCS Encode
(4) Aircraft Radio configuration will utilize this to base communication.

F-2 Portable-to-Portable - Transmit/Receive - Portable Frequency

NOTES: (1) See Table 2-1 for frequency assignments
(2) Do not use CTCS Tone Encode
(3) Used for short range field communications and within buildings.

F-3 Portable-to-Mobile - Aircraft-to-Mobile

OPTION I: When High-Band Ops Channel is Used
Transmit/Receive - Operational Channel

NOTES: (1) See Table 2-1 for Ops Channel frequency assignments
(2) CTCS can be omitted

OPTION II: Use with Option II Mobile Channel Assignment
Transmit/Receive: Mobile Information frequency

NOTES: (1) Used portable-to-mobile and aircraft to mobile or portable
(2) CTCS can be omitted

F-4 Tactical Mutual-Aid - Transmit/Receive: 155.475 MHz,
No CTCS
Use Portable-to-portable/Base/Mobile/Aircraft/Ambulance (emergency only).

Table 2-13 UHF PORTABLE/MOBILE FREQUENCY CHANNEL/LINK USAGE

Portable/Mobile Unit Channels Recommended	City UHF Link (Pairs) Assigned	Remarks
2	1	
4	2 or 3	When configuring channel usage, local and cooperative urban department decisions are recommended after considering the following recommendations:
6	3 or more	

A. TWO (2) FREQUENCY PORTABLE/MOBILE UNIT

Channel	Unit Usage	Functional Recommendations
F-1	Base/Mobile/Portable	Transmit: 465.XXX Receive: 460.XXX Note: (1) Use CTCS Encode/decode (2) See Table 2-9 for city frequency assignments (3) Uses: a. All base-mobile-base and Information activity, Operations intra-agency. b. Mobile-mobile, aircraft-ground, portable-portable operations requiring use of repeater or satellite receiver.
F-2	Mobile/Mobile/Portable	Transmit/Receive 460.XXX Note: (1) Use of CTCS Optional dependent upon mission (2) Uses: Short range mobile-to-mobile or to portable intra-agency simplex communications, i.e. talk around. Also, aircraft to mobile/portable

B. FOUR (4) FREQUENCY UNIT [When (2) UHF links are assigned]

Channel	Unit Usage	Functional Recommendations
F-1	Base/Mobile/Portable	Transmit: 465.XXX Receive: 460.XXX Note: (1) Use CTCS Decode/encode (2) See Table 2-9 for city frequency assignment (3) Uses: a. Base/Mobile/Base Operations/Information activity within a district. (Use second link for a second district)
F-2	Base/Mobile/Portable	(Option 1) Same as F-1 with district assignment of frequencies: 465.YYY 460.YYY uses CTCS (Option 2) Used as city-wide Information channel when F-1 and 460.XXX/465.XXX is used city-wide as Operations Channel. Transmit: 465.YYY Receive: 460.YYY uses CTCS

F-3	Mobile/Mobile and Aircraft/Mobile	Transmit/Receive 460.XXX Used short range for non-emergency Tactical (talk-around) activity. Omit CTCS
F-4	Portable/Portable and Aircraft/portable	(Option 1) Transmit/Receive 460.XXX Omit CTCS (Option 2) Transmit: 460.YYY Receive: 460.XXX Requires similar configuration of mobile and portable Omit CTCS. (Option 3) Transmit/Receive: Neighboring urban mobile transmit frequency used between the two adjoining cities by cooperative agreement. Use CTCS.

C. FOUR (4) FREQUENCY UNIT [Where (3) UHF Links are assigned]

Channel	Unit Usage	Functional Recommendations
F-1/F-2	.. ——	Operates on two district Operations Channel basis as above 460/465.XXX/YYY
F-3	- - -	Operates on city-wide Information Channel 460/465.ZZZ
F-4	- - -	Operates optionally as F-4 above on 460.XXX/YYY/ZZZ. Department operation is sufficiently complex in cities having a population size which justifies three UHF pairs so that firm recommendations must be developed within the department prior to equipment order placement.

D. SIX (6) FREQUENCY UNIT [When four (4) or more UHF links are assigned]

Channel	Unit Usage	Functional Recommendations
F-1/F-2	- - -	District Operational Channel functions base/mobile/portable with repeater.
(F-3*)F-4	- - - ·	District Information Channel functions, mobile-to-base
F-5/F-6		Talk around configuration

*() optional usage in either one or the other configuration

This department configuration is complex and requires local decisions in frequency channel/link configurations.

TABLE 2-14 REGIONAL SYSTEM SITE LOCATION AND ANTENNA CONFIGURATION

REGION 1

Base Station at Sheldon
43° 10' N, 95° 50' W
Tower Height: 300 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8b

REGION 2

Remote Base: New. Centrally located in region, SE of Terrill
43° 15' N, 94° 55' W
Tower Height: 180 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8

REGION 3

Remote Base: New. Centrally located in region, slightly east of Titonka
43° 14' N, 94° 00' W
Tower Height: 180 ft.
Antennas:
High-Band-Specification D-4
Low-Band - Specification D-8

REGION 4

Remote Base: New. Centrally located in region, midway between Osage and Plymouth
43° 15' N, 93° 00' W
Tower Height: 180 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8

REGION 5

Base Station: Decorah
43° 17' 12" N, 91° 50' 42" W
Tower Height: 165 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8

Remote Base at Cresco
43° 21' 00" N, 92° 06' 00" W
Tower Height: 100 ft
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-9

Remote Base at Elkader
42°, 52', 00" N, 91°, 22', 00"W
Tower Height: 120 ft.
Antennas:
High-Band - Specification D-4
Low - Band- Specification D-8

REGION 6

Base Station: Sioux City (north water tower site)
42°, 32', 37" N, 96°, 23', 36" W
Tower Height: 200 ft.
Antennas:
High-Band - Specification D-5 (SE)
Low-Band - Specification D-8b(SE)

Remote Base: 1 mile north of Mapleton
42°, 12',00"N, 95°, 47', 00" W
Tower Height: 150 ft.
Antennas:
High-Band - Specification D-6b (NE)
Low-Band - Similar to D-6b (NE)

Remote Base: New, at Remsen
42°, 46', 00" N, 95°, 57',00"W
Tower Height: 150 ft.
Antennas:
High-Band - Specification D-6b (E-W)
Low-Band - Similar to D-6a

REGION 7

Remote Base: New. Centrally located near Fonda.
42° 34' 00" N, 94° 53' 00" W
Tower Height: 180 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8

REGION 8

Remote Base: New. Centrally located near Eagle Grove
42° 35' 00" N, 93° 58' 00" W
Tower Height: 180 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8

REGION 9

Base Station: New. Iowa Falls
42° 35' 00" N, 93° 58' 00" W
Tower height: 180 ft
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8

REGION 10

Remote Base: New, Near Waverly
42° 45' 00" N, 92° 32' 00" W
Tower Height: 280 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Similar to Specification D-8b, except omni configuration

REGION 11

Remote Base: New, Near Oelwein
42° 40' N, 91° 55' W
Tower Height: 148 ft.
Antennas:
High-Band - Specification D-6b (N-S)
Low-Band - Similar to specification D-6 (N-S)

REGION 12

Remote Base: New. South central Delaware County near Cascade
42° 20' 06" N, 90° 58' 00" W
Tower Height: 240 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8

REGION 13

Remote Base: New. West of Carroll
42° 01' 00" N, 94° 53' 00" W
(This site will have to be carefully selected for a local prominance and may ultimately be moved slightly further west)
Tower Height: 200 ft.
Antennas:
High-Band - Specification D-6b (E-W)
Low-Band - Similar to Specification D-6a.

REGION 14

Base Station: Ames
42° 01' 52" N, 93° 36' 31" W
Tower Height: 200 ft.
Antennas:
High-Band - Specification D-6b
Low-Band -Similar to Specification D-6a.

TABLE 2-14 Cont.

REGION 15

Base Station: Marshalltown (present site)
42° 02' 55" N, 92° 54' 47" W
The present site at Marshalltown is non-prominent, requiring some additional tower height.
Tower Height: 200 ft.
Antennas:
High-Band - Specification D-6b
Low - Band- Similar to specification D-6a.

REGION 16

Remote Base: New. Near Linn County Home
42° 05' 35"N, 91° 32' 55" W
Tower Height: 300 ft.
Antennas:
High-Band - Specification D-6b.
Low-Band- Similar to specification D-6a.

REGION 17

Base Station: Clinton (present site)
41° 50' 48" N, 90° 12' 12" W
Tower Height: 300 ft.
Antennas:
High Band -Spec D-7(W) or equivalent
Low-Band -Specification D-8b (W)
(A relatively large tower is required at Clinton to remain at the present location which is non-prominent with respect to the Western terrain)

REGION 18

Base Station: Council Bluffs
41° 15' 41" N, 95° 49' 33" W
Tower Height: 150 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8

Remote Base: new in SW Shelby County (Near Portsmouth)
41° 37' 30" N, 95° 31' 00" W
Tower Height: 120 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8

REGION 19

Remote Base: New. Centrally located in region near Adair
41° 30'N, 94° 42' W
Tower Height: 180 ft.
Antennas:
High-Band - Specification D-4
Low - Band - Specification D-8

REGION 20

Base Station: New.Dallas county near Waukee operated remotely from West Des Moines
41° 35' N, 93° 55' W
Antennas:
High-Band - Specification D-4
Low -Band - Specification D-8

REGION 21

Base Station: Des Moines (present site)
41° 41' 01" N, 93° 35' 36" W
Tower Height: 137 ft.
Antennas:
High-Band - Specification D-4
Low -Band - Specification D-8

REGION 22

Remote Base: New. Western Marion County
41° 20' 40" N, 93° 16' 00" E
Tower Height: 100 ft.
Antennas:
High-Band - Specification D-6(E-W)
Low-Band -Similar to Specification D-6

REGION 23

Remote Base: New. East of Newton
41° 42' 18" N, 92° 50' 00" E
Tower Height: 147 ft.
Antennas:
High-Band - Specification D-7(E-W)
Low -Band - Specification D-6(E-W)

REGION 24

Remote Base: Near Coralville
41° 43' 45" N, 91° 31' 12" W
Tower Height: 300 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Similar to Specification D-8b except in omni configuration

REGION 25

Base Station: Muscatine (present site)
41° 26' 01" N, 91° 05' 01" W
Tower Height: 1000 ft.
Antennas:
High-Band - Specification D-4
Low-Band -Specification D-8

REGION 26

Base Station: Davenport
41° 31' 01" N, 90° 35' 44" W
Tower Height: 180 ft.
Antennas:
High-Band - Specification D-4
Low -Band - Specification D-8

REGION 27

Remote Base: New. South of Creston
40° 53' 00" N, 94° 22' 00" W
Tower Height: 250 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Similar to Specification D-8, except omni configuration

REGION 28

Remote Base: New. South of Chariton
40° 53' N, 93° 18' 27" W
Tower Height: 200 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Speicification D-8

REGION 29

Base Station: Ottumwa (present site
41° 01' 04" N, 92° 24' 45" W
Tower Height: 300 ft.
Antennas:
High-Band - Specification D-4
Low -Band - Specification D-8

REGION 30

Remote Base: West Burlington
40° 51' 13" N, 91° 18' 00" W
Tower Height: 200 ft.
Antennas:
High-Band - Specification D-4
Low-Band - Specification D-8

REGION 31

Base Station: New.Fort Madison
40° 37' 49" N, 91° 17' 51" W
Tower Height: 80 ft.
Antennas:
High-Band - Specification D-4
Low -Band - Specification D-8

REGION 32

Remote Base: Near centrally located region near Imogene
40°55' 00" N, 95° 26' 00" W
Tower Height: 120 ft.
Antennas:
High-Band - Specification D-4
Low- Band - Specification D-8

2.2.6 TELEPHONE LINK GUIDELINES AND EQUIPMENT FUNCTIONS

Telephone links serve very important functions in law enforcement emergency communications. The primary functions are:

(1) To provide incoming links for emergency requests and complaints from the public in the area served, (See Table 2-8 column 6),

(2) To provide incoming links from associated public safety agencies needing law enforcement emergency assistance. Certain of these may be dedicated dependent upon local usage and relationships of agencies,

(3) To provide outgoing links from dispatchers to operations personnel in law enforcement agencies being served by the dispatch function. Again, certain of these may be dedicated as in (2).

(4) To provide outgoing links from the agency Comm Center to other emergency and public safety agencies operations/communications centers in the area and into adjoining areas. A link to the Highway Patrol Radio Comm Center is a candidate,

(5) To provide two-way administrative and intercommunication (inter-office) links within the agency and to other cooperating agencies.

NOTE: This report addresses the emergency link operations primarily. It must be recognized that communications design practice generally recommends that the emergency operational systems will utilize separate numbers for the administrative links to assure that the busy condition in one system does not cause the other to become loaded.

The objective of this section is to develop general guidelines for telephone emergency systems consistent with those radio system operations. Telephone installations which meet these guidelines will meet the requirements of Section 2.0 Volume II. Additionally, should a community elect to advance their emergency reporting system to a 911 implementation, it will not require a major overhaul of communication center telephone system capabilities for center equipment recommended is identical to that used for 911 system installations.

Specific installations and services are sufficiently different in each Comm Center, therefore, it is recommended that the telephone company business

representative be requested to review specific equipment and services recommendations consistent with the area capabilities and requirements.

There are several guidelines discussed in the following paragraphs which generally must be followed in providing required telephone services to perform the functions for adequate law enforcement telecommunications.

POPULATION BASED GUIDELINES

The number of emergency calls received from the public generally is proportional to the number of persons living in the area being served. Wide variations exist in the hourly call rate during a day and while there are busy hours, true peak message rates occur rather seldom. When they do, the situation is almost always an emergency or disaster and the communications capacity provided should be sufficient to avoid exceeding the recommended message delay. This requires adequate numbers of lines and available equipment to avoid a low grade of service at those times.

Line/radio channel utilization factors and dispatcher loading is greatly dependent upon operating procedures. Recommendations for improvement and dispatch training found in Volume II of this report should be followed for the busy hour utilization factors to be valid. The utilization factor (Erlangs) for emergency lines and radio channel traffic is based upon the population of the area served. These factors were basically derived from a comprehensive study (Reference 2), modified in accordance with survey information from many law enforcement jurisdictions of various urban and rural populations and from data derived in private communication with other consultants. Their usage is shown in Volume II.

Table 2-8 lists the number of incoming emergency lines and the operators required to answer those lines to meet the peak five (5) minute loads at a busy period. The number of peak shift operators shown assumes

a radio dispatcher is responsible for answering a telephone console and operating the radio console. The very large centers show separate telephone consoles having individual operators. These operators hand off messages to the radio operators. Local conditions require some variation in these numbers but, unless specific knowledge exists which justifies changes, these design guidelines should be followed.

It is recommended that the incoming emergency report lines represent, wherever possible, a single dialing number available from all parts of the county/area being served by the Comm Center. These lines should not be used for outgoing calls. The numbers should be published in all telephone directories throughout the area. It should be a responsibility of the Comm Center Director to make local telephone company arrangements for publication.

Emergency lines should be answered by an adequate number of trained dispatcher personnel. These lines should be serviced by a multiple line rotary having a sufficient number to meet the grade of service and accomodate growth for up to ten years. Sufficient instruments should be available to provide the 1 busy in 1,000 calls grade-of-service as required. Law enforcement agencies located at a distance from their Comm Center may have personnel who can economically and efficiently answer local requests during certain hours from persons who wish to avoid a long distance call into the Comm Center. This may be accomplished through use of a Call Diverter equipment in the distant law enforcement agency. Operation of this equipment is as follows:

(1) The telephone instrument is answered normally during office hours,
(2) When the answering officer departs, a switch is thrown on the Call Diverter which causes calls received thereafter to be automatically dialed through to the Comm Center. These are received on a line having an unlisted number or an auxiliary number. Either should identify the calling area,
(3) Automatic dialing of the Call Diverter takes approximately fifteen (15) seconds before ringing occurs at the Comm Center. This delay allows time for a recorded message to inform the calling party

CONTINUED

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that the call will be answered in a few seconds by the area law enforcement Comm Center. The Comm Center Governing Board can determine the method of payment of toll charges incurred. Long distance toll charges are estimated to be much less than the cost of the operations personnel required to man all agency dispatch centers 24 hours per day.

EQUIPMENT UTILIZATION

The telephone instruments recommended for receiving emergency calls and for use in the out-going telephone link dispatch functions represent three (3) categories dependent upon the Comm Center size. (Again, it is recommended that local telephone engineering assistance should be sought for specific implementation designs to meet these guidelines).

Small Comm Centers (Low Population Density Comm Centers)

Comm Centers requiring not more than the 30-button capacity instruments should employ the Call Director console telephone instruments installed at each radio console. These instruments should be wired in parallel with the other instruments. Each will have the following operational characteristics.

- A colored case is suggested to distinguish emergency from all non-emergency telephone instruments. Color code the button modules to distinguish the different groups of incoming lines, outgoing lines, and radio connection lines. The following colors are recommended for the button modules:

  Emergency - incoming lines..... Red
  Agency - incoming lines..... Amber
  Agency - outgoing lines..... Green
  Radio - channel lines ..... Blue

- A hold button to allow holding a received line while dispatching in the radio or onto another outgoing telephone line on the same instrument.

- Visual line status indication is recommended for incoming calls, lines in use and calls on hold. These visual status indicators will use variations of steady illumination, slow and fast flashing for the various line use conditions.

- Recorder connection to connect the telephone to the Comm Center emergency recording channel(s). The recorder tone is not required if agency certify that the service is used exclusively for emergency calls. The line button when depressed will connect that line to the associated recorder channel.

- Telephone line conference - A button controlled module allows connection of any incoming line to an outgoing line in a similar manner as that used for the radio interconnect. This can be used to interconnect to another Comm Center outgoing line or when desired to an inter-office / inter-agency telephone line, allowing the calling party to be connected directly to another office or dispatch center. This feature provides 3-point conferencing capability.

- Radio Connection Module - The conference module may have up to five (5) lines connected into the phone patch equipment for radio system interconnection thus permitting direct two - way communication between authorized personnel calling by telephone from outside the Comm Center and an agency mobile unit. The operator can effect this operation by simultaneously depressing an incoming line button and a conference button (labeled Radio) plus depressing one of the five phone patch buttons to actuate that equipment and provide voice actuated operation (VOX). This feature is recommended for connection into the Operations Channel and normally will be available at only one console position.

Manual override provides the operator an ability to control the circuit and to exercise control should that be required to present unauthorized communication or inadvertant disconnections.

The interconnection interface from the telephone line to the phone patch is usually made through a Bell System QKT coupler for each terminated line. This may vary with other system interconnections.

A card dialer should be employed with the Call Director system to provide a reduced dispatcher work load, for the majority of outgoing calls are made to other agencies with known numbers. In certain areas tone dialing service is available and when it is, additional speed of response is obtained through its use.

Intermediate Size Comm Centers (up to 12 lines):

When the Comm Center line requirements exceed the Call Director 30-button capacity, it is recommended that the recessed-button instrument console be utilized until it is approximately the 80-button capacity. This should allow serving for example up to 12 emergency lines (a total of perhaps three dozen lines total), three (3) radio channels, and four (4) consoles with conferencing and a phone patch interconnects.

The functions of the recessed-button instrument are identical to that of the 30-button Call Director described for the Comm Center of small size and provides the increased line and interconnect capacity required for larger centers.

Larger Comm Centers (Greater than 12 lines):

Those Comm Centers that encompass both large city law enforcement and also handle single county or multiple county emergency reporting and dispatching involving a large number of incoming lines and where 911 reporting is eminent should utilize a more efficient switching system, namely the Bell System 310 PBX or equivalent. The functions provided by such a system allows efficient dispatch handling of land line to radio interconnections plus a high volume of incoming and outgoing calls and conferencing just as required for the small/intermediate centers.

In larger locations this type of system should be used because of the volume of calls to be handled, the number of lines used and the interconnecting capabilities that should be made available for efficient operation. Many operations are built into this system to improve efficiency relative to operations performed manually in the keyed telephone equipments.

Single Number Emergency Reporting:

The reporting of complaints and emergency service requests for law enforcement and other public safety services is now dependent upon a wide variety of calling numbers in most of the counties of Iowa. Local law enforcement agency telephone numbers are displayed in telephone directories. Many of these numbers are not answered on a twenty four hour basis. Many agencies do not have a direct dispatch by radio to mobile units capable of action so the call must be relayed through a second or third agency before action can be taken. This leads to delays and sometimes errors due to lost or misunderstood information.

There is a nationwide recognition of the need for area-wide single number emergency request services. The National Criminal Justice Commission in Standard 23.1(6) established a nation-wide goal for single number calling. Ref. 1(f). Implementation of the single county Comm Center system makes more feasible a rapid response to requests received from citizens, for relay of messages is then unneccesary. Mobile units can be directed to the scene immediately after a message of request is received. The primary problem remaining is that too often there are several seven digit numbers used within a given county for such emergency calls. There is not a solution which will provide a single seven digit calling number for counties.

The 911 emergency reporting system provides this feature, has only three dialing digits and is gaining in nation-wide recognition for its simplicity.

Features of the 911 Reporting System

Many communities are installing the 911 system service with cooperation of the telephone company or companies serving it. The use of 911 is suitable for many Iowa counties, particularly those having in them large population centers. Example costs have been estimated by Northwestern Bell Telephone analysts for generic city and county units. These costs are listed in Volume II Section 4.4.4 with an explanation of their installation configuration.

Exact costs can be provided by the telephone company representatives to any community or region upon request of the authorized public safety authorities and upon specification of their operating requirements. The operating requirements of this report represent a realistic forcast of need.

The criteria for development of 911 systems provides the following operational features:

(1) All 911 trunks from remote wire centers are dedicated, direct access circuits coming to the Comm Center. They are equipped to provide called-party-hold, emergency-ring back and forced disconnect features,

(2) 911 trunks to remote wire centers are based on two minimum per wire center and a total requirement based on one trunk per 2500 main stations,

(3) Emergency calls in the Comm Center are handled by:
   a. Multiline telephones of either the Call Director or recessed-key arrangement for small and medium sized centers just as recommended in this plan.
   b. Dispatch switching system (310 PBX or equivalent) for fast and efficient handling of emergency calls in larger installations,

(4) Features for visual signals, recorder and radio connections, conferencing and automatic ringback are required as specified for the emergency telephone services of this plan.

In centers where 911 is utilized the following additional features should be available:

Emergency Ringback-

The Comm Center operator is able to ringback a calling party after that party has disconnected (returned to on-hook) to obtain missing information, to provide additional instructions, etc. This works with a "called party-hold" feature.

Forced Disconnect -

The Comm Center operator is allowed to force a disconnect with a calling party should that call be intended as disruptive or having intent to tie up incoming lines.

2.2.7 DATA COMMUNICATION GUIDELINES FOR USAGE AND FUTURE PLANNING

Present data system communications requires that each Comm Center have one or more TRACIS terminals available for usage to access the state TRACIS data bank, NCIC and to allow TTY point-to-point communications between Comm Centers.

The larger Comm Centers have access to a local data system (LENCIR, etc.) which in turn allows access to the state and national systems. It is recommended that regardless of data system usage, a concerted effort be made by each Comm Center Governing Board to coordinate policies for improving data files and to standardize formats for data retrieval and transmission to mobile officers. Automated information systems are technically available today although none yet are economical or highly desirable from the viewpoint of the mobile operator.

It is recommended that available mobile data system evaluation results conducted by other states and in their cities be reviewed periodically by the Division of Communications with regard to establishing at least one or two active agency trial usages of the best of these. Proposals for federal aid should be considered to fund these projects.

A major growth in future state-wide communication systems will be data communications. The present state-wide system already includes a rather large data network in TRACIS. With the increasing need to communicate tax, auto registration, health, etc. data in addition to law enforcement data among the various local, county and state government agencies, there is a growing need for a master plan which will accommodate data transfer as an integral part of the state-wide voice communications system.

Clearly, the data communications requirements for various municipal and county governments varies widely dependent largely on population. The county and city with a relatively small population has a relatively small requirement for data transmission. Consider, for example, a county with a population of 10,000 and a vehicle registration of 5,000. Each auto registration requires approximately 200 characters (letters and/or numerals) to uniquely define the name and address of the owner, description of the vehicle, and tax information. This totals one million (1,000,000) characters of information which

must be transmitted, and with eight (8) bits per character, eight million (8,000,000) bits. To transfer this data at teletype speeds (120 - 150 bits per second) would require a total of approximately fifteen (15) to eighteen (18) hours. If this were transmitted on a daily basis over sixty (60) working days, the data could be transferred in fifteen (15) to eighteen (18) minutes per day. A teletype bit rate device would probably be sufficient and transmission cost minimal. If the transmission rate were 1200 to 2400 rather than 150 bits per second, the data could still be transmitted over voice grade lines with no special conditioning and with better efficiency in line usage. Assuming that other data transmission requirements would probably not exceed those of peak vehicle registration periods, a county or town with a smaller population base could be adequately served by a dial-up system on teletype or voice grade lines.

A larger county or city might require higher data transfer rates. For example, a county with a population of fifty thousand (50,000) for vehicle registration alone might require seventy five (75) to one hundred (100) hours of transmission time at teletype speeds. This, along with other data transfer requirements, could mean several hours of transmission per day. Clearly, voice lines speeds (up to 4800 bits per second) would be the more attractive option for such an agency. Moreover, a larger agency will require an increased number of data transfer transactions. Hence, a dial-up might be marginal for an agency in this size range, and perhaps, a switched leased line network might be more appropriate for county and city governments of this size.

As agency size grows, its data transmission requirements tend to grow out of proportion to its size. A county with a large population may, for example, be providing services (e.g. data processing) to surrounding smaller counties. Hence, some of these larger counties data transmission requirements may require high speed transmission on wide-band lines (up to 40,800 bits per second) on permanently connected leased lines.

Certain special applications, such as TRACIS, may best be served with a switched leased line network or a multiplexed data network.

It may be predicted that the requirements of the component subsystems will be widely varied. Relative costs, response time requirements, and data transfer requirements will determine the most cost-effective methods to use

for the various components of a state-wide data communications system. At present there seems to be no definition of future data communications requirements which would provide the information necessary to develop a master plan. It is recommended that the Director of Communication study present requirements and evaluate them to define projected requirements to enable the later development of a long-range plan.

The long range communications master plan must accommodate the different types of data and voice subsystems of all local, regional and state agencies to insure total system compatibility. Without such planning, the system will be unwieldy and difficult to link together. Moreover, a poorly planned system may eventually lead to a cumbersome data base, excessive telecommunications costs, and difficulties in allocation of resources, not to mention unnecessary and time consuming procedural problems for the terminal operators.

The master plan must be flexible, however, It must permit the system to evolve in different ways. It should call for defined interfaces between and among voice and data subsystems which, in turn, should be no more complex than the current state-of-the-art can support.

A master plan should be designed to accommodate proliferation of component subsystems. It should also be designed such that an individual agency component can be upgraded (for example, from dial-up to leased line) without a major investment in time, effort, and hardware. Component subsystems which may be considered related to the law enforcement communications include:

(a) TRACIS and other information systems equipped for two-way mobile and base (information center) transfer via radio channels,

(b) Remote radio system control for Iowa Highway Patrol Radio system, EMS communications radio remote bases, law enforcement county and regional remote radio base stations,

(c) Potential data transfer for automatic vehicle locator systems should there be a need for auxiliary channels for radio base-to-mobile links.

2.2.8 SYSTEM IMPLEMENTATION PLANNING AIDS

The effectiveness of communications and information transfer within each county and region in Iowa is entirely a function of how well each county or region organizes and implements its communication system and utilizes its Comm Center in compliance with the overall Iowa Telecommunications Plan.

The purpose of this section is to provide implementation guidelines for the conversion of present and projected communication system requirements into a set of effective system implementation equipment lists. The development of base station subsystems is less dependent upon local conditions than Comm Center subsystem developments. The planning of this section is an effort to simplify the Phase III implementation plan development as much as possible for the user.

A "work sheet" approach to utilizing the specification U, control (radio) console, and developing communication center functional specifications is described in this section. It is recommended that such an approach be used for the purposes of:

(1) Collecting all significant facts relative to specific agency Comm Center needs,
(2) Identifying the specific functions which the Comm Center must perform,
(3) Summarizing these Comm Center functional specifications in such a fashion that procurement implementation and adequate documentation for servicing and expansion may follow.

In general, there are three (3) types of communications link interfaces within a region, county, or city communications system:

(1) Interface links between the city, county, or regional communication system and persons and agencies outside of the jurisdictional or administrative boundaries of the communications system. The inter-agency links are summarized in Table 2-15 and show the channels used to accomplish the interface to the particular system element (Center, base radio subsystem, mobile, etc.),
(2) Communications link interfaces between the element within the communications system, with emphasis on the intra-agency linkages between

elements and the communication center. These linkages and interfaces with channel usage are summarized in Table 2-16,

(3) Interfaces between the various equipment and operating personnel within the Comm Center, are developed by the work sheet, Table 2-17.

It is clear that the functional specification requirements which result from describing the type (3) interface cannot be defined until the interface types (1) and (2) are defined for the communication system.

A graphic illustration depicting all communications links and which is descriptive of the elements composing a generalized city, county, regional communication systems is given as Figure 1-2. Not all communication elements shown are applicable to a specific communication system.

In medium and high population density areas, the communications system may be more or less complex than shown in the generalized diagram. The increased complexity may be the result of having a city communication system, perhaps of comparable complexity, within the geographic boundaries of a county or regional communications system.

NOTE: When the generalized communications system diagram is applied to a non-integrated large city-only communications systems, the base station Tactical and Information high-band subsystem is not used because this subsystem is only in the county-wide system. Thus, there are variations in the application of the general communication system configuration due to the elimination of some elements or the number or quantity of a specific element. These variations are a function of the area and city population base and local planning decisions are necessary to determine if cities and counties will have separate Comm Centers.

Recalling that there is no economic justification for a county or regional communication system for an area with a population base of less than 35,000, the county or regional communication system may be characterized by one of the generic communication system types defined by Table 1-1.

The work sheet approach does not require agency personnel or their contractor to fill out any specific forms but only to list and to display the information in a work sheet format which is clear and useful. The resulting work sheet

will collect in one location the specific information which is relative to the city, county, group of counties or region communications system for purposes of defining the communication links, link functions, system elements, personnel, and the specific equipment and communication functions which are needed to satisfy the objectives of this plan. The resulting equipment requirements may be compared with the existing equipment and facilities in the geographical and administrative area of interest to determine what, if any, equipment or facilities need to be acquired, leased, constructed and manned. Further, the information organized on this work sheet assists in clarifying the work content of the functions performed by a Comm Center via its consoles and personnel.

A work sheet may be prepared for any city, county, or regional communications system, and in the event that the county or regional communication system has one or more communication systems within it, separate work sheets are advised for each system.

The following steps will be employed in developing a work sheet:

(1) Development of heading data - used to identify the area served, characteristics and approach to the type of system to be developed.
(2) List communication interfaces - between the city, county or regional system and all outside agencies.
(3) Identify and list all communication links which exist between a city, county, or region communication system.
(4) List equipment, hardware, and personnel requirements needed to implement the city, county or regional communication systems.

Guidelines for work sheet development are given in Table 2-17. Information sources are provided to cross-reference the information sources contained in tables and figures of this report.

Table 2-15 SUMMARY OF POSSIBLE COMMUNICATION LINK INTERFACES BETWEEN A CITY, COUNTY OR REGIONAL COMMUNICATION SYSTEM AND AGENCIES OUTSIDE OF ITS AREA OR ADMINISTRATIVE BOUNDARIES

Communication System Elements		Possible Link to Other Agency		Channel Used
1.0	Communication Center Dispatch/Operator	1.1	Other LEA Comm Center (City, county, etc.)	Radio PTP, Telephone and Teletype
		1.2	EMS (Communication Center(s)	Telephone
		1.3	Data Sources (TRACIS, NCIC, LENCIR, Other)	Teletype
		1.4	City Communication Center within area	Telephone/Radio PTP
		1.5	Iowa Highway Patrol Radio Comm Center	Telephone/Radio PTP
		1.6	Other LEA/PS mobiles	Radio Tactical or Information
		1.7	Emergency Request	Telephone (Incoming)
		1.8	Administrative	Telephone
2.0	Mobile in System	2.1	IHP Mobiles	Radio-Tactical or Wide Area
		2.2	Other mobiles	Radio-Tactical
		2.3	IHP Comm Center	Radio-Wide Area
3.0	Portable Unit	3.1	IHP Mobiles	Radio-Tactical
		3.2	Other LEA/PS Mobiles	Radio-Tactical
4.0	Aircraft	4.1	Other Agencies (Limited)	Radio-Portable Transmit Frequency (Non-TCS)

LEGEND:

LEA Law Enforcement Agency
PTP Point-to-Point
PS Public Safety
IHP Iowa Highway Patrol (Mobile)
IHPR Iowa Highway Patrol (Radio Comm Center)

Table 2-16 SUMMARY OF POSSIBLE COMMUNICATION LINK INTERFACES BETWEEN A CITY, COUNTY OR REGIONAL COMMUNICATION CENTER AND SYSTEM FUNCTIONS AND ELEMENTS WITHIN ITSELF

System Function		Interconnection of System Elements		Channel Used	Link Detail
1.0	Operations	1.1	B-M, M-B	LB Radio-Ops	No. & Freq. Assignments
		1.2	B-M, M-B	HB Radio-Ops	No. & Freq. Assignments
		1.3	Within City	UHF Radio-Ops	No. & Freq. Assignments
2.0	Information	2.1	B-M	Radio-Info	
		2.2	Source	Teletype	No. & Type Required
3.0	Tactical	3.1	M-B, B-M, M-M	HB Radio	Frequency Assignments
4.0	Other Agency	4.1	P-to-P	HB Radio	No. & Freq. Assignments
		4.2	P-to-P	Telephone	No.
		4.3	P-to-P	Teletype	
5.0	Emergency Requests and Complaints	5.1	Incoming	Telephone	No. Required for each type (list)
6.0	Administrative	6.1	Telephone	Telephone	No. as Determined on Local Basis
7.0	IHPR or other agency Hot Line	7.1	Telephone	Dedicated	Specific for Agency
8.0	Remote Base or Repeater Repeater	8.1	Control and Monitor	Land Line	Telephone
9.0	Officer Direct	9.1	Portable	Radio	No. & Frequencies

TABLE 2-17 WORK SHEET DEVELOPMENT

STEP NO.	STEP DESCRIPTION	INFORMATION REQUIRED	INFORMATION SOURCES
1.	List heading data	Region No. System Generic Category Prepared by and date	Figure 1-1 p. 18 Table 1-1 p. 19 Table 2-4 p.440
2.	Define area served	Develop the following tabularization GENERAL DATA: County No. / County Name / CTR* Loc. — CITY DATA**: City Name / Co. Seat or loc. / Population (1000,s) 20 to 50 / over 50 * Check this column to indicate physical location of the Communication Center (s), recalling that MPD and HPD may have more than one. ** List only those cities where a Communication Center will exist.	Local data and information sources from Step 1.
3.	List links between communication system and other persons or agencies.	List each link and specific name of outside agency For each link list the type of link (radio and frequency, TTY, telephone, etc.)	Table 2-15 p. 76 Figure 1-1 p. 18 Table 2-9 p. 52
4.	List all links between elements of the communication system.	List each link defining the type of link and its frequency assignment, including special requirements such as repeater control, tone code frequencies, security requirements, etc.	Table 2-16 p. 76 Table 2-1 p. 33 Figure 1-1 p. 18 Table 2-15 p. 76 Table 2-9 p. 52
5.	Sketch elements of communication system without internal details of the Communication Center.	Prepare sketch in informal block diagram form showing only those links and blocks of equipment which represent your system.	Table 2-16 p. 76 Figure 2-1 p. 32 Figure 2-2 p. 38 Figure 2-3 p. 39 Figure 2-4 p. 43 Figure 2-6 p. 47 Previous work-sheet data.

6.	List system element hardware requirements, other than inside the Communication Center.	Using work sheet step 5, on a link-by-link basis, develop a list of specific hardware specifications required. Note that certain hardware may be multi-functional, and guidance in developing hardware lists is given in Sections shown.	Section 2.2 p. 26 Table 2-4 p. 49 Table 2-5 p. 44 Table 2-6 p. 44 Table 2-7 p. 45 Table 2-11 A/B p. 54/55
7.	Prepare list of equipment needed to accomplish desired communication system objectives.	Using an inventory of existing equipment within the boundaries of your communication system, identify those equipment which are suitable for the new system and compare with the list of Step 6 to create an "equipment requirements" listing.	Step 6 Local data Table 2-10 p. 53
8.	List all communication links between the Communication Center and system elements and outside of system agencies or contacts.	Develop a Communication Center link list and also indicate interfaces with auxilary power, local intercom systems, burglar alarm systems transmitter/receiver control links and all other interfaces.	Step 5
9.	Define Communication Center size, noting the special requirements for cities of 20,000 or greater population.	Using Table 2-8, the center size may be defined in terms of the number of dispatcher (radio and telephone) work positions required. Using Table 2-8 the telephone dispatchers and radio dispatchers are considered to be the same person unless a telephone operator is shown as in Waterloo with 5 telephone and 3 radio dispatchers would need 3 dispatchers who handle radio and telephone plus 2 dispatchers using telephone only on peak shift.	Table 2-8 p. 49
10.	Prepare list of equipment types needed to develop a satisfactory Communications Center.	With the communication links defined in Step 8 and the number of radio and telephone dispatch stations defined in Step 9, develop a list of Communication Center equipment requirements to include the scope of capabilities (i.e. no. of channels, specific frequencies, etc.) in terms of functions which each equipment must perform.	Step 8 Step 9 Section 2.1.2 p. 25
11.	Prepare equipment specifications for purposes of acquisition of equipment.	Using the equipment specification guidelines provided in the Appendix to Vol. I, assemble a complete package of equipment specifications.	
12.	Prepare system functional specifications for purposes of implementation.	System functional specifications are a statement that the installer must provide a system which meets certain minimum performance standards. Include warranty and maintenance specifications, as well as a set of job description and operational guidelines for administrative purposes.	

2.2.9 SYSTEM PERFORMANCE EVALUATION

System performance is determined through evaluation of many factors as discussed in Section 3.4 and 3.5 of Volume II. Upon completion of a system installation, it is not economically feasible to evaluate at once all of the factors, especially those which have message traffic relationships. These must be evaluated on a periodic basis through use of recorded operative data.

An immediate need exists to evaluate each specific system as it becomes operational in order to ascertain the correctness of design and installation of components.

During the operational life, a continuing evaluation can relate to overall performance and operational efficiency.

Accordingly, the following paragraphs provide suggestions for measuring the system initially and on a continuing basis.

One of the most important operational performance factors is the ability of a system to provide readable signals in the remote areas of jurisdiction or most difficult propagation situation in that specific area.

When the transmitters and receivers are fully operational and after mobile radio units are installed and checked locally, the following steps should be taken to assure system operational performance:

1) Send one or more mobile units into the area designated in Table 2-18 for the specific county. Actually, all mobiles should be operated in this "worst-case" area as an assurance that <u>all</u> have expected performance.
2) Operate using test transmissions on Operations Channel for several typical messages in both mobile-to-base and base-to-mobile mode. Both the base operator and the mobile operator should record the number of words not clearly understood (because of radio system breaks or noise). Operation should be performed at different headings of the mobile and within a two or three mile vicinity of the worst location until at least fifteen (15) sets of transmissions are completed,

3) Perform the same tests for the Information Channel and Tactical Channel,
4) If the Wide-Area Channel is operational, check similarly the performance at various county locations noting the location (the worst case for this channel is not the same as for the other channels),
5) Assemble Operations, Information and Tactical Channel data from both operators after the test. There should be greater than eighty percent (80%) of words intelligible for each channel (Except Wide-Area).

If certain mobile units seem to operate at less reliability than others, check the installation particularly that of antenna and transmission line.

If there is a significantly different result between the Operations Channel and the Information, Tactical Channels, check the antenna transmission line, and forward/reflected power ratios and filter installation for correctness.

After system check out and acceptance, the Comm Center Supervisor should keep accurate records of reported areas of marginal reliability from all mobile operators. The total area should not exceed one percent (1%) of the jurisdiction when using the following formula;

$$\frac{(\text{County Area} - \text{Marginal Area})}{\text{County Area}} \times 100\%$$

A check out of each operational functions on the console(s) and in the Comm Center should be performed.

These would include:

a) Transmitter keying - all channels, both local and remote,
b) Transmitter channel switching - all frequencies,
c) Microphone channel switching and compression amplifier check out,
d) Audio distortion,
e) Monitor receiver operation; rf squelch, CTCS decode, and audio output level, muting levels, etc.,
f) Recorder channel operations for each telephone, radio input and output line. Check remote play back control,

g) Test all systems when operating on emergency power to determine if noise, power, or frequency fluctuations are troublesome,

h) Emergency power supply functioning at rated load. Automatic cut-over and return to commercial power OK.,

i) Simultaneous operation of Operations and TIPS Channels with not more than 3 dB degradation of co-located receiver performance due to desentization or intermod product signals,

j) Installed equipment shall be properly grounded and be hazard-free to users and maintenance personnel per OSHA guidelines and local electrical codes.

A radio subsystem checkout of the following should be performed for each radio channel:

a) Transmitter power output,

b) Standing wave ratio,

c) Receiver sensitivity,

d) Receiver squelch sensitivity and tone decode capability,

e) Filter insertion loss and desired attenuation response checks,

f) No destructive intermod products shall be generated by simultaneous operation of any combination of co-located transmitters which will desensitize, capture, or otherwise degrade nearby communications equipment of other agencies, such as Fire Department, local government, etc,

g) Intermod product signals, spurious and harmonic radiations from nearby transmitters (other agencies or communication services) shall not cause destructive interference to the law enforcement communication systems. Corrective action, such as filter installation on the offending equipment, shall be requested of the licensee and/or owner of such equipment.

Checkout The Antenna Tower:

Antenna support structures shall conform to FAA lighting and painting requirements. In addition, such structures shall be certified by the installer to be structurally adequate for the antenna and transmission line loads. The items listed in the Specification T should be checked for conformance at the time of installation.

Use recorded data for messages on each channel type to evaluate the:

a) Message length averages for telephone and radio,
b) Message rates. These should be displayed to show the channel utilization average for 24 hours, the busy hour average and the peak busy hour for both radio and telephone,
c) Channel utilization should be computed based upon the above data record,
d) Total telephone utilization (emergency requests) should be analyzed and compated to predicted levels and to system design criteria used in system design,
e) Total radio utilization (sum of all radio channels) should be analyzed and compared to predicted levels and system design criteria,
f) Comm Center staff evaluation and adjustments can be based upon these results and future expansion plans can be supported by these results.

TABLE 2-18 COUNTY LOCATIONS FOR WORST - CASE SIGNAL RELIABILITY CHECK OUT

REGION 1	
Lyon	Extreme NW corner
O'Brien	NW, SW corners
Osceola	NE corner
Sioux	Extreme NW corner

REGION 2	
Clay	At Peterson, north end of Pickerel Lake
Dickinson	Extreme SW corner
Emmet	NE, SE corners
Palo Alto	NW corner, above Mud Lake

REGION 3	
Hancock	NW, SW corners
Kossuth	NE, NW corners
Winnebago	NE, NW corners

REGION 4	
Cerro Gordo	At Meservey, Dougherty
Floyd	SW corner near Coldwater Creek
Mitchell	Extreme NE corner and along Wapsipinicon River
Worth	SW corner near Beaver Creek and Route 9

REGION 5	
Clayton	Route 13 NE corner, Extreme SE corner on Mississippi
Allamakee	NE, SE corner, routes 182 and 13 respectfully
Howard	SW corner near the Waspsipinicon River
Winneshiek	NW corner, near upper Iowa River, NE corner east of Locust

REGION 6	
Cherokee	SW corner near Pierson Creek
Ida	NW corner near Achton Creek
Monona	SE corner
Plymouth	SW corner of county on route 12
Woodbury	SE of Danbury

REGION 7	
Buena Vista	NE corner near Pickerel Lake and in the NW corner (Wanata State Forest Preserve)
Calhoun	NE corner
Pocahontas	Extreme NE corner
Sac	Extreme NW corner SW corner on Route 4

REGION 8	
Hamilton	South of 383 on Bear Creek (SE corner)
Humboldt	NW, NE corners
Webster	SE corner, near Des Moines River
Wright	Extreme NW, SE corners

REGION 9	
Franklin	Near Oakland (SW corner)
Hardin	Extreme NW corner

REGION 10	
Blackhawk	Extreme SW, NE corners
Bremer	Extreme NE corner on the Little Wapsipinicon
Butler	1 mile east of Ackley on U.S. 20
Chickasaw	Extreme NE corner south of Protivin

REGION 11	
Buchanan	NE corner on Maquoketa River, SE corner
Fayette	At Jesup, Oelwein

REGION 12	
Delaware	Near Colesburg on Little Turkey River at Sand Springs
Dubuque	SE, NE corners on Mississippi Bluffs
Jackson	On route 67, NE and SE corners on river bluffs

REGION 13	
Carroll	SE of Coon Rapids
Crawford	NW corner (near Soldier River)
Greene	SW corner

REGION 14	
Boone	SW corner
Story	Extreme NE, NW corners

REGION 15	
Marshall	NW, SW corners
Tama	NE, NW corners

REGION 16	
Benton	South of Belle Plaine on 21
Jones	Extreme NE corner
Linn	Extreme NE and NW corner

REGION 17	
Clinton	Extreme NW corner

TABLE 2-18 Cont.

REGION 18	
Harrison	NW, SE corners
Pottawattamie	Near Walnut, north of Elliott
Shelby	NW, SE corner

REGION 19	
Adair	NE corner on I80
Audubon	Extreme SE corner
Cass	At Dewey(SE corner)
Guthrie	North of Adair on 90, South of Coon Rapids on 141

REGION 20	
Dallas	West of Dawson on 141
Madison	Extreme SW corner

REGION 21	
Polk	Extreme NE, NW corners

REGION 22	
Marion	at Newbern, Hamilton
Warren	NW, SE corners

REGION 23	
Jasper	At Vandalia, NW and NE corners
Poweshiek	NE corner along Walnut Creek

REGION 24	
Cedar	2½ miles east of the Linn, Cedar County junction a along the North boundary
Iowa	At North English, SW, SE corners
Johnson	Extreme NW corner of county
Washington	Extreme NW corner and at River Junction.

REGION 25	
Louisa	At Gladwin
Muscatine	Extreme NE corner on Route 6

REGION 26	
Scott	Route 22 near Camp Abe Lincoln - Extreme NW corner

REGION 27	
Adams	East of Nevinville
Clarke	SW corner
Decatur	SW corner
Ringgold	NE corner near Sand Creek
Taylor	East of Lenox
Union	NE of Lorimar

REGION 28	
Appanoose	NE, NW corners
Lucas	NW corner
Monroe	NW corner
Wayne	West of Lineville

REGION 29	
Davis	SW corner, Des Moines River
Jefferson	Near
Keokuk	Extreme NE, SE corners
Mahaska	NE corner near Barnes City
Van Buren	NE corner
Wapello	SW, NE corner

REGION 30	
Henry	2 miles north of Winfield, West of Wayland on 78
Des Moines	On route 99 at Louisa Co. Border

REGION 31	
Lee	SW of Keokuk on US 61 (Mo. border) Extreme NW Lee Co on State route 16

REGION 32	
Fremont/Mills	County line on 59 just north of Imogene
Montgomery	Extreme NE, NW corners
Page	Extreme SW, NW corners

2.3 FUNDING GUIDELINES

The money required for the implementation of the communications system described in this plan may be made available to the ultimate user through a combination of federal, state, county, and/or municipal government funding sources. Federal assistance for funding projects of this type are available from the (1) Law Enforcement Assistance Administration (LEAA), (2) Civil Defense (CD), (3) U. S. Department of Transportation (DOT), and etc. on various matching fund bases. The approval of plans for federal funding and allocation of funds are usually handled by one or more state agencies, e.g., (1) the Iowa Crime Commission for LEAA funds, (2) the State Office for Civil Defense for CD funds, and (3) Office of Planning and Programming and other State Departments for DOT funds. The matching funds are usually provided by the county or municipal governments. Some state funds for authorized programs may also be available for matching purposes on federal grant projects.

The following information is intended to provide summary assistance to agencies which may wish to apply for funding assistance:

1) Funding Through the Iowa Crime Commission -

   A large percentage of the funds to be used in the implementation of this law enforcement communications system in the various counties, regions, or areas of Iowa will be obtained through the Iowa Crime Commission as the state administrator for LEAA funds. For fiscal years 1974, 1975, and 1976 (the Federal fiscal year is 1 July through 30 June) the cash match amount required is ten percent (10%) of the cost of the approved projects. Thus, during these three (3) fiscal years, ninety percent (90%) of the project cost will be covered by federal money. The ten percent (10%) cash match must be provided by the city or county governments involved. No federal revenue sharing money can be used for purposes of this cash match. It is possible that some amount of "state buy-in" will be available as part of the ten percent (10%). The amount of state money which will be available for this purpose has not been established at this time (January, 1974). Reversion funds from FY73 and FY72

may be available at a seventy-five percent (75%) federal and twenty-five percent (25%) local matching ratio.

FY74 area plans and funding have already been approved and budgeted. Area plans for FY75 funding must be submitted to the State Planning Agency of the Iowa Crime Commission before 30 June 1974 in accordance with the following procedure:

(a) If this report is approved by the Iowa Crime Commission and the LEAA Regional Office (Kansas City) any unit of government seeking funds for communications equipment must first contact their Area Crime Commission Project Director. In conjunction with that Area Director, develop a specific communications system implementation plan for the particular city, county, or region which is in conformity with this report. Section 2, this volume provides detailed information and guidance for this development. In developing a detailed plan for a city, county, or region, it must be remembered that the Iowa Crime Commission can authorize purchase of only law enforcement radio equipment and that equipment specifications must be included with the plan submittal. Reference, Section 8, Volume II of this report for procurement procedures recommendations.

Figure 2-8 shows which counties are located in the eight (8) Crime Commission areas and Table 2-19 lists the name of the Project Director and Fiscal Officer for each area, the location of their office and the office telephone number.

(b) The Area Crime Commission Project Director must include the communications equipment request in the area plan. That plan must be submitted to the Area Crime Commission for approval and establishment of priorities. If the communications equipment request is included in the area plan and priorities, an application will be prepared and submitted to the Iowa Crime Commission.

Approval or denial of this application request usually requires ninety (90) days.

(c) No bidding, vendor selection and resulting purchase orders for communications equipment may be issued until the "Approval of Grant" form has been received by the Area Project Director and forwarded to the communications system contracting officer,

2) Funding Through the State Office of Civil Defense - Funds are available through the State Office of Civil Defense when matched with local money if specific criteria are satisfied in contructing a Comm Center located in an approved "Emergency Operating Center" (EOC). An EOC facility must have some degree of fallout protection and the necessary staff and communications to provide direction and control for government emergency functions. CD funding may also be authorized for a mobile or transportable Comm Center for use in emergencies as an alternate communications resource .

"Four elements are basic to operation of an EOC: (1) fallout (radiation) protection, (2) trained people to carry out essential EOC functions; (3) communications and warning capability, and (4) necessary equipment and supplies."[13] Also see References 14 and 15.

The details of these elements are provided in the latest version of the referenced documents. Assistance in planning an EOC and establishing its fundability is readily available through the county CD Directors' Office or the Iowa State Office of Civil Defense, Lucas Building, Des Moines. However, planning an EOC must be preceded by the establishment of a county emergency plan ,

3) DOT Funding-

U. S. Department of Transportation (DOT) funds as administered by the Highway Safety Program Director of the Iowa Office of Planning and Programming are available for approved programs through state departments whose functions are related to highway safety improvement. In general, these programs are related to the improvement of highway safety as described below:

(a) Department of Public Safety

DOT funds are available through the Iowa Department of Public Safety for police traffic enforcement programs. Such local programs must:

(1) Provide a significant improvement over present conditions or operations.

(2) Be part of a comprehensive area plan

(3) Must be processed by the Department of Public Safety.

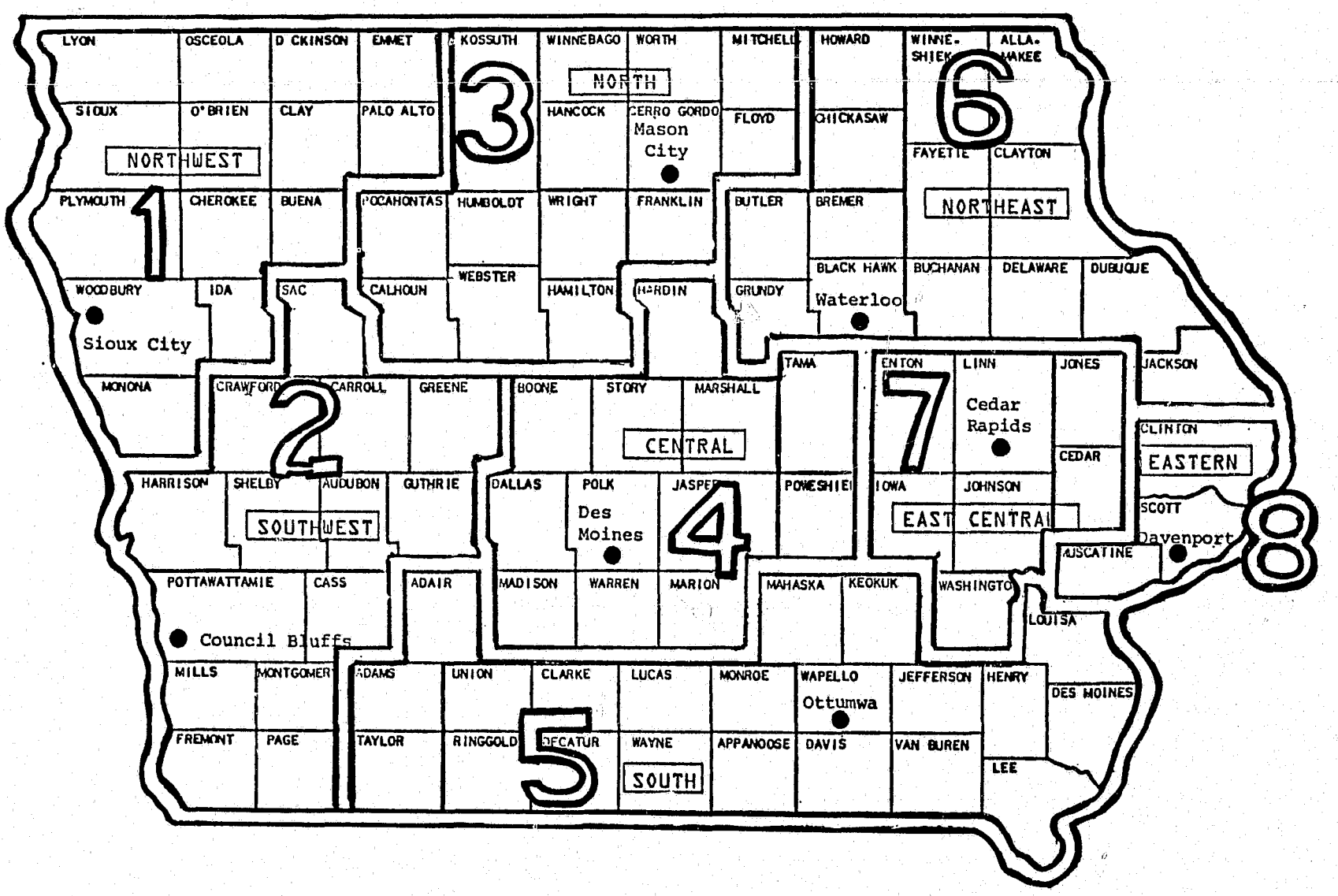
These funds cannot be used for capital improvements, but can be used to provide plan execution, training of personnel, and for communications equipment. The amount of funding obtainable will be in direct relationship to a documented percentage of the programs' involvement with traffic safety. Any equipment obtained with these funds must be dedicated to that program under which it was purchased for a period of time defined as the "guideline life" of the equipment in the latest issue of the U. S. Internal Revenue Service Publication Number 456 entitled "Depreciation - Guidelines and Rules - Revenue Procedure 62-21". The use of the equipment for the required period of time on a given program must be documentable.

(b) Department of Health

At the present time (January 1974) certain DOT funds are available through the Iowa Department of Health for purchase of ambulance vehicles, ambulance radios, medical

equipment, rescue equipment and emergency medical technician-ambulance (EMTA) training. An effort is being made to expand this fund availability to include the needed Comm Center equipment for Emergency Medical Services radio communications.

FIGURE 2-8 IOWA CRIME COMMISSION
AREA DELINEATION



10-2-72

Table 2-19 IOWA CRIME COMMISSION AREA DIRECTORS

01 - NORTHWEST IA. AREA CRIME COMM.
630 Insurance Exchange Building
Sioux City, Iowa 51101
PHONE 722/252-4569 or 4560
Mr. Dean Haze, Project Director
Mr. Ron O' Neal, Fiscal Officer

02 - SOUTHWEST IA. AREA CRIME COMM.
4621 North 82nd Street
Omaha, Nebraska 68134
PHONE: 402/571-4172
Mr. John Langley, Project Director
Mr. Gerald C. Peterson, Fiscal Officer

03 - NORTH IA. AREA CRIME COMM.
P. O. Box 380
202 First Street S. E.
Mason City, Iowa 50401
PHONE: 515/424-5834
Mr. Allen R. Way, Project Director
Mr. Robert O. Bowen, Fiscal Officer

04 - CENTRAL IA. AREA CRIME COMM.
104½ E. Locust
Des Moines, Iowa 50309
PHONE: 515/283-1521
Mr. Ronald C. Middleton, Project Director
Mr. Russell G. Lull, Fiscal Officer

05 - SOUTH IA. AREA CRIME COMM.
P. O. Box 943
Fairfield, Iowa 52556
PHONE: 515/472-5017
Mr. Gordon E. Plepla. Project Director

06 - NORTHEAST IA. AREA CRIME COMM.
City Hall
715 Mulberry
Waterloo, Iowa 50703
PHONE: 319/291-4416
Mr. James Kilman, Project Director
Mr. Marvin Bartels, Fiscal Officer

07 - EAST CENTRAL IA. CRIME COMM.
4403 First Avenue S. E.
215 Executive Plaza Building
Cedar Rapids, Iowa 52401
PHONE: 319/393-9507
Mr. John R. Kellogg, Project Director
Mr. Gerald S. May, Fiscal Officer

08 - EASTERN IA. CRIME COMM.
1001 Kahi Buidling
Davenport, Iowa 52801
PHONE: 319/322-6121
Mr. Emanuel Podurgal, Project Director
Mr. William J. Mc Clurkin, Fiscal Officer

2.4 COMMUNICATIONS CENTER OPERATIONS MANAGEMENT

Management of a county-wide or a multi-county law enforcement Comm Center is important to ensure that center operations policies are established and that operations are conducted in a professionally competent manner, consistent with recognized standards and in keeping with the requirements of all user agencies.

The achievement of this management function requires a Communications Governing Board to provide an effective management method which can provide a professionally integrated dispatch operation. The Board is responsible to all law enforcement and public safety agencies which vest their responsibility to it for communication of complaint response and dispatch control to their officers.

It is recommended that:

1. A Communications Governing Board of approximately eleven (11) members should be established as soon as it is determined that this plan will be implemented.
2. The election or appointment of Board members should ensure representation of all user agencies or groups of agencies from within the county or from a group of counties (region). (See the suggested agency representation lists).
3. An agency representative member should be appointed by the agency management on the basis of his knowledge and experience in law enforcement communications and may be an individual now responsible for the present agency communications supervision and operations functions.

Suitable representation is gained for each county or region board, when each of the following agencies or groups of agencies appoint representatives.

County Sheriff
County Seat and Major Community Police Departments
County Civil Defense Director
County Seat Fire Department (ex officio)
Other Public Safety Agencies (ex officio)

Responsibilities of the Communications Governing Boards include at least the following areas of activity:

1. Determine the facility in which the Comm Center will locate to provide adequate space, working conditions and physical security,
2. Determine the degree of participation desired by all cooperating agencies,
3. Prepare or contract preparation of the specific requirements of the county-wide communications system:
   a) Radio base station elements
   b) Telephone, both emergency request, inter-agency (outgoing/incoming) and administration
   c) Mobile and portable radio units
   d) Data system (TRACIS, LETS, County information system, etc.),
4. Select either a suitable antenna tower site or determine the suitability of the present tower and site,
5. a) Prepare the system implementation grant for the county law enforcement communications system,
   b) Provide purchasing policies and oversee procurement for the communications system after approval has been granted by funding authorities,
6. a) Provide the impetus for preparation of applications for the official APCO frequency coordination and FCC license changes,
   b) Provide assurance that FCC license renewals are current for each associated facility,
7. Develop policies for center operations, funding and maintenance cost proration to the user agencies,
8. Use guidelines for selection, conduct interviews, evaluate and employ a Communications Center Director,

9. Develop policies for dispatch procedures, records development/usage:
   a) Message priorities, all agencies,
   b) Network discipline,
   c) Use of procedural codes,
   d) Message security devices,
   e) Log keeping
   f) Record retention,
   g) Reports to individual agencies,
   h) Evaluation of emergency response time, dispatch action response time and other performance evaluation,
10. Utilize dispatcher job descriptions, selection and evaluation guidelines and assure the Comm Center Director is following those in developing and maintaining a capable dispatcher staff. Volume II has a set of recommended guidelines for these,
11. Develop a policy for training of all dispatchers and officers in the dispatch procedures and network discipline. Volume II has in it a list of training guidelines.
12. Develop system maintenance policies and performance evaluation for assuring equipment reliability. This can be via in-house maintenance or contract maintenance technicians. See Volume II,
13. Maintain a planning function for development of the county system implementation at a functional level which meets the growing requirements of the communities and agencies served by the center.

The Governing Board of each Comm Center must hire a Director for their center. Job descriptions for the Director position and that of center personnel are provided in Volume II of this report.

3.0 RECOMMENDATIONS

3.1 CONTRACTOR RECOMMENTATIONS:

The following recommendations are prepared by Spectra Associates for the guidance of agency management personnel (county supervisors, sheriffs, city council members, city commissioners, chiefs of police, etc.) who are responsible for the preparation of plans for upgrading the law enforcement communication system under their administration.

1. It is recommended that each county organize a Governing Board of user agencies in order to develop this implementation plan in their jurisdiction. See Section 2.4

2. It is recommended that system planning be performed in accordance with the guidelines of this plan, in order to obtain an approved LEAA grant request. (See Section 2.3 of this volume) The Area Crime Commission Project Director should be contacted for guidance in plan development. The county sheriff's office should assume responsibility for preparing the grant requests for implementation,

3. It is recommended that a high planning priority be given to implementing the Tactical Subsystem (TIP) and the high-band mobile units (see Section 2.2.8). In this regard, contact the Area Crime Commission Director for status of federal grant funding for this system. Obtain from the Department of Public Safety a set of Rules and Regulations for operating on the public safety emergency radio communications channel (Tactical Mutual-Aid Channel, 155.475 MHz),

4. It is recommended that when planning is contemplated involving either Grundy, Washington, Decatur, Van Buren, and Crawford Counties, that additional site location cost effectiveness and signal reliability analysis be performed by a competent communications system engineer based upon the available sites and to optimize the selection of Comm Center city locations for the county or region,

5. It is recommended that the Governing Board work with the Crime Commission Area Director and other funding agencies to develop grant requests for partial funding of the installation (See Section 2.3),

6. It is recommended that telephone company business and engineering representatives be requested to review specific equipment and service requirements for each Comm Center planning consistent with each county agency's capabilities and requirements of this plan (See Section 2.2.6),

7. It is recommended that incoming emergency request lines, represent wherever possible, a single dialing number which is available within all parts of the area being served by the Comm Center. The 911 system is the only known configuration providing this feature,

8. It is recommended that upon establishment of a county Comm Center, there be published in telephone directories of that county, telephone numbers for calling that center for emergency services. This call will enter the center via a multiple line rotary,

9. It is recommended that the emergency request telephone system utilize separate calling numbers from those of the administrative system to assure that the busy conditions of one system do not cause the other to become overloaded,

10. It is recommended that planning in each county include the 911 for county seat cities and especially for cities having a population of 10,000 or more. Larger metropolitan area 911 services should include an area which extends to the limits of toll-free service,

11. It is recommended that regardless of data system usage, a concerted effort be made by each Comm Center Governing Board to coordinate policies for improvement of data files and to standardize formats for data retrieval and transmission to mobile officers,

12. It is recommended that Governing Board personnel and Center Directors plan to enter into a contract for maintenance services to assure continuing specified performance of the system functions. See Section 7.0 of Volume II,

13. It is recommended that the system operation be evaluated at least once during each year to determine its effectiveness. See Section 3.0 Volume II and Section 2.2.9 of this volume,

14. It is recommended that the Comm Center operating procedures, disciplines and code usage be coordinated state-wide and allowances made for dispatcher training in these procedures (See Section 6.0 Volume II). There are plans being developed by the Iowa Highway Patrol Communications Director to offer this service to Iowa law enforcement agencies.

3.2 LEATAC RECOMMENDATION

The procurement process for specific agencies involves the response of two or more bidders to the system specifications. During a bidders' conference there can arise a need to consider deviations and exceptions to the system and/or the equipment specifications listed. Control must be exercised that any deviations or exceptions will not cause this plan to be thwarted in its effectiveness or for the specific system to fail to meet a required performance. In recognition that the specific application of this planning study will need to be shaped in each installation, the LEATAC meeting on 12 February 1974, preliminary to approval, noted to include the following requirements:

Deviations or exceptions to minimum standards of the Specifications set forth in this report may be allowed under the following conditions:

(1) The deviation or exceptions must be compatible with the plan,
(2) Any deviation or exception request must be reviewed by the Iowa Crime Commission and the LEATAC Committee, or its equivalent and approved by both,
(3) That the bidder shall guarantee any system for which any deviation, or exception has been allowed.,
(4) That the vendor shall guarantee such systems so approved for a period of one year after acceptance.

4.0 DEFINITIONS AND EXPLANATION OF TERMS

Agency	A term used to identify a law enforcement organizatio or group of organizations using the communications system. Usage of the term with a modifier such as sheriff agency or city law enforcement agency refers to the generic sheriff agency or the generic city law enforcement agency.
CTCSS	Continous Tone Code Squelch System Sometimes the final "S" is omitted when referring to the tone itself or the encode or decode function.
Channel	An assigned communications transmission service function. More than one path or link may serve a functional channel requirement. 1) Specifically for this report Information Channel functions for the transmission of information (data) requests and receiving the information. 2) Tactical Channel - functions to provide the mobile-to-mobile Mutual Aid communication related to inter-agency and intra-agency criminal apprehension activities and for transient assistance. 3) Operations Channel - functions to provide the routine communications between mobile units and their Comm Center operational comman and control dispatch. 4) Wide-Area Channel - functions to provide specific mobile-to-mobile communications between units of a given agency

Channel (cont'd)	over distances beyond that possible unit-to-unit. Second, it will provide an inter-agency vehicle extended range in sheriff-to-city or to IHP mobile officers.
Comm Center	The facility complex of equipment and personnel from which all communications activity for a specific agency, county, or regional group of agencies is controlled.
Dispatchers	The personnel who are assigned the Comm Center radio operator function and the emergency request/complaint channel response function.
Generic System	A system model which describes the general characteristics, channels and frequency usage for a number of typical or of aggregate characteristics for several agencies.
IHP	Iowa Highway Patrol mobile unit
IHPR	Iowa Highway Patrol Radio. The operational radio Comm Center, a base/repeater station or frequency may be referenced.
LEA	Law Enforcement Agency (s). Reference all agencies in Iowa unless modified such as "city LEA's".

DEFINITIONS (con'd)

LEATAC	Law Enforcement Administrators Telecommunications Advisory Committee.
Link	The transmission - reception equipment and medium forming a two-way path for communications in a particular channel. A frequency or frequencies are associated with radio links.
MCA	Marginal Coverage Area This term relates to the signal area where signal reliability is less than a specified amount, e.g. 50% service probability index.
Maximum Peak Message Rate	The number of messages which are transmitted during the busiest five (5) minute period of a busy hour. In this report, the predicted message traffic values for radio and telephone are the maximum peak message rates. This assures an adequate system channel capacity for the public safety emergency stress periods.
SPI	Service Probability Index This term describes the statistical reliability and confidence factor associated with the Longley - Rice propagation prediction program for computer analysis.
TTY	Teleprinter for data services.

5.0 REFERENCES

1. National Conference on Criminal Justice January 23-26, 1973.
   Standards:
   (a) 1.4 Communicating with the Public
   (b) 5.1 Responsibility for Police Service
   (c) 8.1 Establishing the Role of the Patrol Officer
   (d) 8.3 Deployment of Patrol Officers
   (e) 9.7 Criminal Investigation
   (f) 23.1 Use of the Telephone System
   (g) 23.2 Command or Control Operation
   (h) 23.3 Radio Communications

2. Illinois Police Communications Study, Phase II, Volume I.
   "Allocations of Spectrum to the Police Radio Service", IIT Research Institute, Chicago, Illinois, LEAA N169 003, Volume I, December 1969.

3. Police Telecommunications Systems
   Project Three, Phase Three; APCO, Inc. June, 1971.

4. "Trunk Loading Capacity - Full Availability Erland B Equation"
   Bulletin 485, Automatic Electric Company, 1953.

5. Iowa Telecommunications Plan - Law Enforcement and Civil Agencies
   Phase I, Final Report, 15 October, 1973. Spectra Associates, Inc.

6. Kryter, K.D. "Methods for the Calculation and Use of the Articulation Index". Journal of the Acoustical Society of Americ, Volume 34 pages 1689 - 1697, 1972.

7. Longley, A.G.; Rice P.L.; "Prediction of Tropospheric Radio Transmission Loss over Irregular Terrain - A Computer Method", ESSA Technical Report ERL - 79 - ITS67.

8. Iowa Offical Register, 1971 / 1972; Sixty fourth General Assembly.

References Cont.

9. "An Emergency Medical Services Communications Plan for the State of Iowa", Iowa State Department of Health / DOT / NHTSA, 28 February, 1973, Spectra Associates, Inc.

10. "Iowa Law Enforcement Agency Telecommunications Plan Interim Report" - Phase II, Spectra Associates, Inc. 30 September, 1973.

11. Horn, D.W. "Selection Through Use of Radiation Pattern", IEEE Vehicular Technology Group 1973 Conference, October 1973.

12. "Batteries Used with Law Enforcement Communication Equipment - Comparison and Performance Characteristics". LESP RPT 0201.00 U.S. Depart - ment of Justice; LEAA, National Institute of Law Enforcement and Criminal Justice, May 1972.

13. "Development of Emergency Operating Centers", Part E, Chapter 2, Appendix 1 of Federal Civil Defense Guide, September, 1966, Department of Defense, Officer of Civil Defense.

14. "Emergency Communications", Part E, Chapter 3, February 1967.

15. "Federal Contributions for Civil Defense Equipment", Part E, Chapter 5, Appendix 1, January 1970.

16. "Mobile Emergency Command Post", APCO Bulletin, February 1973.

17. "Emergency Communications Van", APCO Bulletin, October, 1973.

18. "The Public Safety Communications, Standard Operating Procedure Manual", APCO 1972.

19. State Communications Committee (APCO) Meeting Minutes of December 15, 1969.

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