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PORT OF EMERGENCY MEDICAL SERVICES

November 1973

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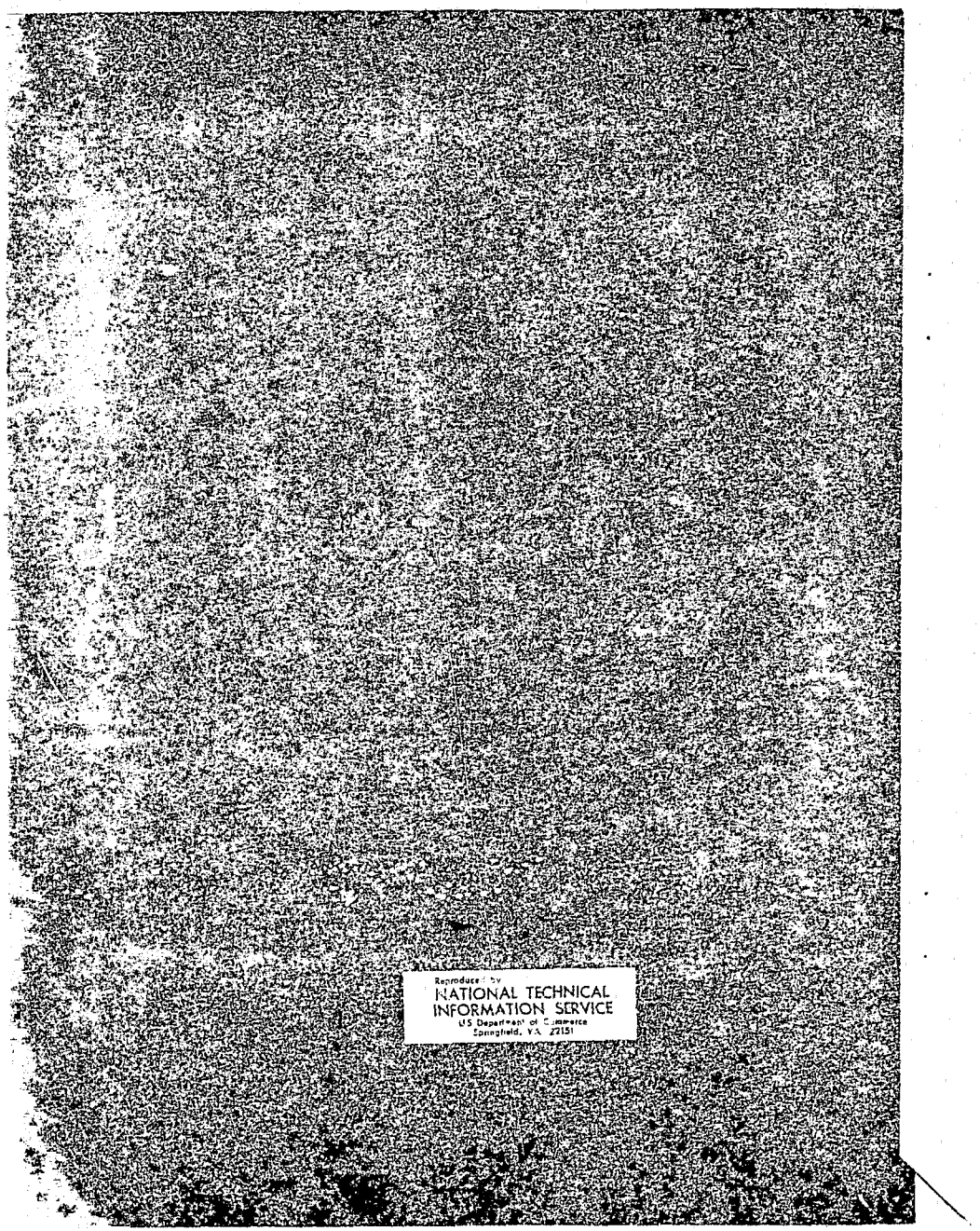
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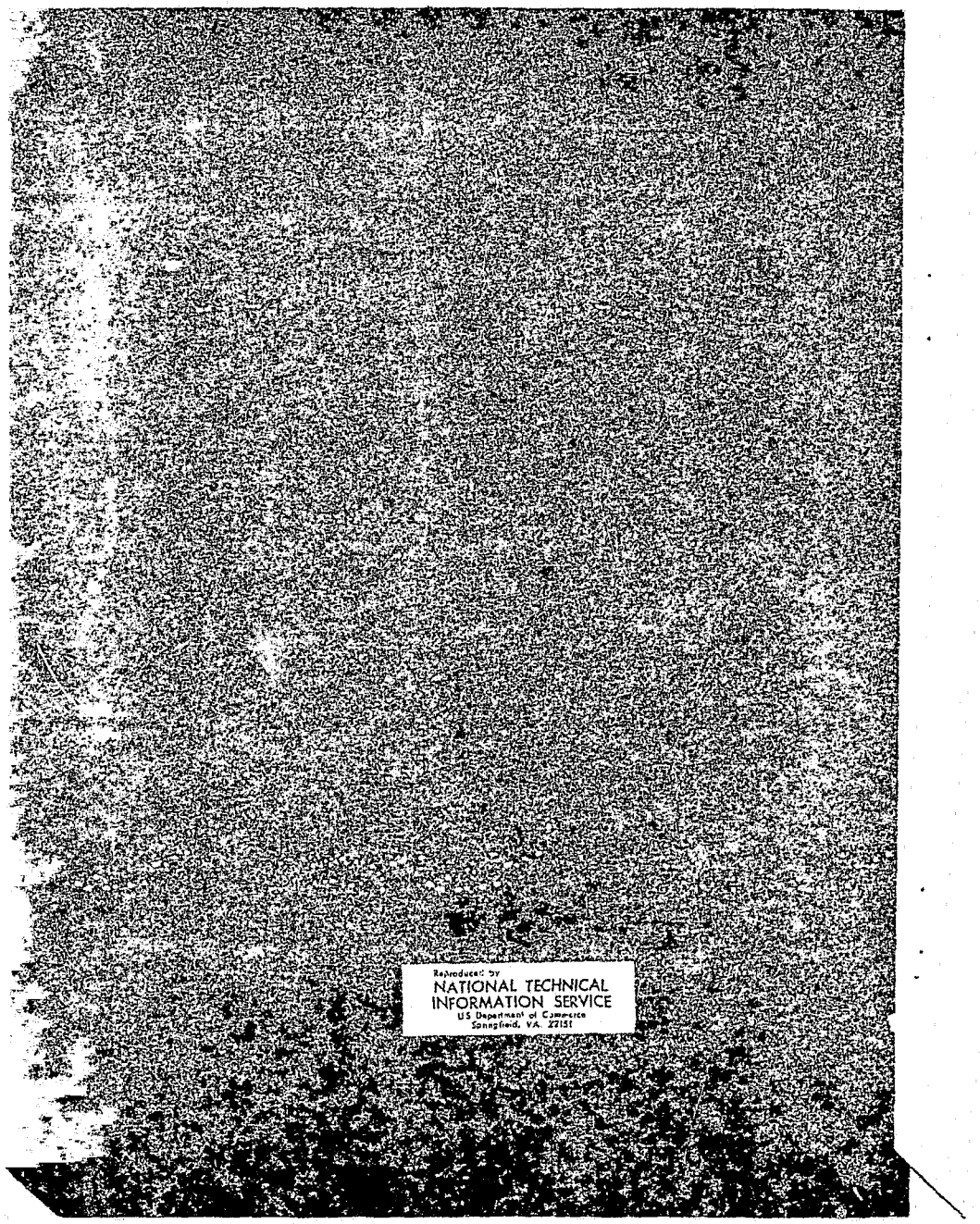
COMMUNICATIONS IN SUPPORT OF EMERGENCY MEDICAL SERVICES

NOVEMBER 1973



COMMUNICATIONS IN SUPPORT OF EMERGENCY MEDICAL SERVICES

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INTRODUCTION AND SUMMARY

In his Health Message to the Congress of March 2, 1972, President Nixon stated:

> "Emergency Medical Services: By using new technologies to improve emergency care systems and by using more and better trained people to run those systems, we can save the lives of many heart attack victims and many victims of auto accidents every year. The loss to the Nation represented by these unnecessary deaths cannot be calculated. I have already allocated $8 million in fiscal year 1972 to develop model systems and training programs and my budget proposes that $15 million be invested for additional demonstrations in fiscal year 1973."

Emergency medical services involve initial treatment of the acutely ill and the severely injured, reporting of medical emergencies, and patient care enroute to hospital facilities. Electronic communications makes it possible to quickly and reliably link ambulances, medical personnel at the scene of an emergency, and hospital emergency facilities, to enable early diagnosis and treatment of patients.

In making it possible for Emergency Medical Service (EMS) interests to undertake communication systems planning, certain practical factors were taken into account, namely:

- EMS is a rapidly emerging service.
- EMS is developing at the "grass roots" level.
- Probably more than most other types of service, EMS is reflective of local circumstances.
- EMS communications of the future will be building from a base of existing equipment investments.

This report provides for an EMS communications system plan adaptable to both urban and rural areas. Specifically it provides for:

- Establishment on a national basis of common radio frequencies for use by EMS units at the scene of medical emergencies, wherever occurring.
- Paging systems that would be used not only for EMS but also to contact members of the general medical community.

GSA DC 74-5741

— Dispatching and direction of ambulance operations, e.g., instructions to drivers as to which hospital to go and traffic conditions enroute.

— Communication networks for biomedical telemetry (electrocardiagrams, for example), medical data handling, and special voice circuits for exclusive use by doctors.

The importance of communications to effective, affordable EMS is now firmly established. Therefore, the report includes a recommendation that an Emergency Medical Radio Service be established and accorded the same status and protection throughout the United States as Police and Fire Radio Services.

This report, prepared by the Interdepartment Radio Advisory Committee, in coordination with members of the Federal Communications Commission staff and the medical community, deals with EMS communications, including the provision of radio frequencies, as foreseen up to the early 1980's time frame. It was approved by the Director of the Office of Telecommunications Policy and forwarded to the Chairman of the Federal Communications Commission on October 3, 1973.

PART I - GENERAL

There is a ground swell of concern and interest in improving emergency medical services. This has been prompted by the realization, among other things, that (a) the Armed Forces having proved that the number of otherwise fatal combat casualties could be reduced substantially by prompt medical attention, the same concepts could be applied effectively to civilian life throughout our country, and (b) aerospace technology, with some adaptations, could make this a practical undertaking. The effectiveness of these concepts has been dramatically demonstrated by projects and programs such as the Illinois Trauma Center, the Jacksonville, Florida, Houston, Texas, and San Francisco, California EMS Systems, and the Military Assistance to Safety in Traffic (MAST) program.

In the past six years there has been an outpouring of activity among professional, lay, and governmental organizations toward upgrading emergency medical care. Concern over deaths from accidents and other medical emergencies has been expressed in legislation establishing national standards for EMS and providing funds for implementation, research and development. Technology and methodology for delivering high quality emergency medical care exists for each element of the EMS system. What is lacking in most areas of the nation is informed cooperative linkage of elements for optimum performance, and the radio frequency spectrum allocations which facilitate system development. IRAC Ad Hoc 120[1] undertook an extensive review of the communications aspects of EMS as a prelude to preparing recommendations regarding the radio frequencies needed therefor on a national basis.

An indication of the magnitude of the problem is revealed by the following quote from a March 1972 Report of the Committee on Emergency Medical Services of the National Academy of Sciences—National Research Council (NAS/NRC):[2]

> "Accidental injury and acute illness generate a staggering demand on ambulance and rescue services, allied health personnel, physicians, and hospitals for the delivery of emergency medical services. Accidental injury is the leading cause of death among all persons aged 1 to 38. Each year more than 52 million U.S. citizens are injured, of whom more than 110,000 die, 11 million require bed care for a day or more, and 400,000 suffer lasting disability at

1. The Interdepartment Radio Advisory Committee (IRAC) established a special Ad Hoc group to undertake a study of and to prepare a report on Emergency Medical Service (EMS) communications. This group became known as "IRAC Ad Hoc 120".
2. Roles and Resources of Federal Agencies in Support of Comprehensive Emergency Medical Services - published by Committee on Emergency Medical Service, National Academy of Sciences-National Research Council, March 1972.

> a cost of nearly $3 billion in medical fees and hospital expenses and over $7 billion in lost wages. Those requiring hospitalization occupy an average of 65,000 beds for 22 million-bed days under the care of 88,000 hospital personnel. This hospital load is equivalent to 130 500-bed hospitals. Of the more than 700,000 deaths from heart disease each year, the majority are due to acute myocardial infarction and more than half of these deaths occur before reaching a hospital. Approximately 40 million persons seek care each year in hospital emergency departments as a result of accidents, heart disease, stroke, poisoning, diabetic coma, convulsive disorders, and many other illnesses."

In furtherance of the foregoing quote, research by members of Ad Hoc 120 revealed certain nationwide statistics for 1972 as follows:[1]

EMERGENCIES ON THE NATION'S HIGHWAYS	
INJURIES REQUIRING TREATMENT	3,551,000
DEATHS	54,862
ALL INJURIES REQUIRING TREATMENT	51,229,000
REQUIRING BED CARE	12,014,000
DEATHS	114,864
HEART ATTACK DEATHS	744,658

With regard to these statistics, a consensus of the medical profession indicates that:

> 20% of the annual accidental deaths could be prevented with prompt and proper care at the accident scene and with efficient transport to a suitable medical facility.
>
> 25% of the annual cardiovascular deaths could be prevented through public education and the provision of prompt and adequate treatment.
>
> 15% of the 56,000 highway deaths could be prevented as demonstrated in Illinois by a statewide system of regional hospital trauma centers supported by a communication network and an ambulance system of highly trained attendants.[2] The major improvement can be expected in rural areas where 65-70% of highway deaths occur. In 1971 it was reported by the Division of Emergency Health Services of USPHS, DHEW, that while 50% of the ambulances in the country had two-way radio communications with a dispatching center, less

1. National Safety Council: Accident Facts 1972.
2. Boyd, D.R.; Mains, K.D.; and Flasher, B.A.; A Systems Approach to Statewide Emergency Medical Care, J. Trauma 13:276, 1973.

> than 10% maintained such communications with hospitals or their emergency departments.[1]
>
> The first 30 minutes following an injury or heart attack generally determines whether the victim will live or die.

The policy of the Administration in the area of emergency medical service is clear. In his State of the Union Message to Congress of January 20, 1972, the President said:

> "We must develop new ways of organizing emergency medical services and of providing care to accident victims. By improving communications, transportation, and the training of emergency personnel, we can save many thousands of lives which would otherwise be lost to accidents and sudden illnesses. Such improvement does not even require new scientific breakthrough; it only requires that we apply our present knowledge more effectively."

The foregoing was reinforced on March 2, 1972 in the President's Health Message which stated:

> "Emergency Medical Services: By using new technologies to improve emergency care systems and by using more and better trained people to run those systems, we can save the lives of many heart attack victims and many victims of auto accidents every year. The loss to the Nation represented by these unnecessary deaths cannot be calculated. I have already allocated $8 million in fiscal year 1972 to develop model systems and training programs and my budget proposes that $15 million be invested for additional demonstrations in fiscal year 1973."

There is hardly a Federal Government department or agency that is not involved in some aspect of EMS.[2] DOT, HEW, and Defense Departments[3,4] plus the Veterans Administration clearly have major investments and resources to be devoted to EMS. Other Federal departments and agencies with major responsibilities or interests in EMS include Justice, Labor, HUD, Agriculture, Interior, Commerce, NASA, the Special Action Office of Drug Abuse Prevention, and the Appalachian Regional Commission.

1. Ambulance Services and Hospital Emergency Departments, USPHS, HSMHA, DHEW, Rockville, Md., 1971.
2. Roles and Resources of Federal Agencies in Support of Comprehensive Emergency Medical Services" - published by the National Academy of Sciences-National Research Council, March 1972.
3. The Defense Civil Preparedness Agency has 3803 State and Local Emergency Operating Centers completed and in process throughout the nation. (See Appendix C.)
4. The Highway Safety Act of 1973 in Sections 212A and 212B requires DOT to study greater citizen involvement in highway safety programs, including accident detection, reporting, and response. While not specifically stated, EMS is assumed to be included (and clearly should be).

The NAS/NRC has recommended that an Interagency Coordinating Group on Emergency Communications be established in the Executive Office of the President under the leadership of OEP[1] and OTP for coordination of resources of all Federal agencies whose support of communications systems is related to the roles of emergency response agencies at the local, regional, state, and national levels.[2] The major EMS activities, however, will take place within the states and their political subdivisions. The capabilities developed and used on a day-to-day basis are for the most part the same resources which mobilize to meet widespread emergency and disaster needs. For communications purposes, many such operations will be under the purview of the Federal Communications Commission. Federal Government departments and agencies will be using EMS systems extensively and dovetailing their operations as appropriate with local authorities. Thus EMS systems involve an intermix of "Federal Government and non-Federal Government" interests. EMS systems further involve intermixes of public-safety capabilities, whether public or private, including volunteer agencies.

It is not the purpose of this report to discuss the entirety of EMS but only to develop background that would help identify the telecommunications requirements thereof that would, in turn, identify the radio frequency requirements from now through the early 1980's time frame. This general background section has been included to present some feeling for the scope and critically important nature of the subject of EMS, and to establish that the interests involved are truly "Government and non-Government".

1. Since the disestablishment of OEP in mid-1973, responsibility for planning emergency response to disasters is with the Federal Disaster Assistance Administration, Department of HUD.
2. Roles and Resources of Federal Agencies in Support of Comprehensive Emergency Medical Services - published by the National Academy of Sciences-National Research Council, March 1972.

PART II - TELECOMMUNICATIONS ANALYZED

In his testimony before the House Subcommittee on Public Health and Environment on March 15, 1973, Dr. John S. Zapp, Assistant Secretary for Legislation, HEW, described community emergency medical services as follows:

> "Community emergency medical services consist of the detection and reporting of medical emergencies, initial care, transportation and care for patients enroute to hospital facilities, medical treatment for the acutely ill and severely injured within hospital emergency departments and provision of a linkage to continued care and rehabilitation. Emergency medical services are composed of elements which should be organized into a balanced system at the local level. This system is part of the community's total health care delivery system, and therefore must be planned for in conjunction with that total system and should provide immediate access to that system through appropriate diagnosis, treatment, and follow-up care."

Accepting the foregoing as a definition of EMS, the members of Ad Hoc 120 then analyzed the needs of the medical and health professions for emergency telecommunications services. In summary, these professions require telecommunications to permit:

1. Human health emergencies to be immediately reported to appropriate community agencies which manage and control health resources and services.
2. Appropriate health resources to respond to such human emergencies at anytime and wherever they may occur.
3. Recognition of the need for (and more immediate response to) health resources and services to life threatening emergencies within a time period which will insure the greatest saving of lives and limbs.
4. Health agencies and professionals to marshall their individual and collective resources (staff, equipment, supplies) and coordinate their responses in the shortest effective time to meet any human need including catastrophic events.
5. Health agencies and physicians to provide guidance and direction to others on the scene of a human emergency pending arrival of trained health personnel.

1. Hearing before the Subcommittee on Public Health and Environment of of the Committee on Interstate and Foreign Commerce, House of Representatives on the "Emergency Medical Services Act", Serial No. 93-8, March 15, 1973.

6. The coordination of emergency health services with other emergency service systems within the community through Emergency Operation Centers or other means.

7. Special health resources (emergency departments, intensive care and coronary care units, burn and trauma facilities etc.) to be utilized to their most effective degree.

8. Transmittal of all appropriate vital human physiological information necessary during any emergency to the proper monitoring and decision making health professions and their centers.

9. Collecting, recording, and documenting information on human emergencies in order that emergency health care systems can review, revise and reorganize, as necessary to meet changing conditions and needs.

10. Safe transfer of acutely and chronically ill patients between health care facilities.

11. Optimum use of health resources in preventing or mitigating adverse medical effects of human emergencies.

An analysis of these requirements in graphic form is set forth in Appendix A hereto. An EMS system provides services affecting the sequence of events. The capability of the resources and the quality of their performance relate to the results, i.e., facilitate definitive medical care and faster patient recovery.

Telecommunications in support of EMS appear to fall into the following categories:

1. Messages related to reducing response time, i.e., dispatching and controlling the movement of emergency vehicles (Radio and/or wire).

2. Messages related directly to the patient and his care, i.e., medical telemetry and a "doctor's talk" channel (Radio).

3. Extensions of both 1 and 2, above, from the emergency vehicle to the actual location of the patient, e.g., in an apartment, in a field, or on a boat, etc. (Radio).

4. Messages necessary for effective coordination and preparedness for reception of the patient, i.e., intra-hospital, hospital-to-hospital, and Resource Coordination Communications (RCC) Center (wire/radio).

5. Paging systems to call individuals and mobilize medical personnel. While these are now mostly "beep" systems, two-way portable radio paging is the desired objective (Radio).

6. Interface with police, fire, and other local government agencies (Radio and wire).

7. Disaster situations (Radio and wire).

Not included in the above are the communications that would be used for entering the emergency response system. Undoubtedly the telephone will continue to be the primary means of "reporting" an emergency medical situation remote from the hospital. The national emphasis on implementation of the universal telephone emergency number, "911"[1], provides the citizen an easily remembered emergency access number. A by-product of the "911" system is expected to be a marked increase in coordination among agencies providing emergency services. This increased coordination has been taken into account in the body of our study by the frequent references to use of Resource Coordination Communications (RCC) Centers. The members of Ad Hoc 120 agreed that "reporting", being so diverse in its origins, and since "911" service was expanding anyway, should be excluded from its study because it is an entirely different subject.

A multitude of technological advances have been made in the telecommunications area (as well as in other areas) and are pertinent to EMS. Heretofore, the relation of such advances to an entire EMS system has not always been considered. Among such technological advances are:

1. Citizen access to the response system through the universal emergency telephone number ("911"), and Resource Coordination Communications (RCC) Centers to manage the dispatch of ambulances, flow of medical information, and control of action taken.

2. Digital communication units and base terminals which have encouraged the standardization of brevity codes related to patient care, dispatch, and decision making.

3. Equipment developments for "cellular modes" of communication in the 900 MHz area.

4. Telemetric monitoring of life signs of patients in medical emergencies for physicians and technicians in hospitals.

5. Specialized patient transportation units, such as mobile intensive care units.

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1. OTP Bulletin No. 73-1 of March 21, 1973, "National Policy for Emergency Telephone Number '911'."

6. Air ambulance operation using both rotary and fixed wing aircraft. Aircraft can be used for emergencies, routine transfer of patients between hospitals, transfer of patients to specialized treatment centers, or even for the transfer of vital organs and medications.

7. Minicomputers for operation in hospitals and communication centers to include management of resources, provide automatic dispatch and routing, and assist in decision making.

8. Television communications between the paramedic at the site and the hospital physician.

The members of Ad Hoc 120 made a determination that special EMS frequencies need not be provided for the interface with fire, police, or other local government services or for disaster situations. However, FCC Rules should permit these interfaces. In other words, communications (to interface with police, fire, and other local government agencies and to cope with disaster situations) should be arranged, it was felt, on the basis of "operations plans" using established resources available to "Resource Coordination Communications (RCC) Centers rather than to attempt to earmark additional separate frequencies for such purposes. Ad Hoc 120 noted that the Defense Civil Preparedness Agency has more than 3800 local Emergency Operating Centers completed and in process throughout the Nation.[1] There is a requirement for EMS calling, working, and "scene of action" frequencies for use when divergent EMS facilities (ambulances particularly) converge in one area or move from area to area. Frequencies for these purposes are recommended in Part IV of this report. There would be no reason why an RCC could not put fire, police, and other emergency vehicles on these frequencies for rescue communications purposes.

1. See Appendix C.

PART III - PRESENT SPECTRUM SITUATION

To date the Federal Communications Commission has provided frequencies in the 30-50 MHz and in the 155.13-155.430 MHz bands for base and mobile operations for general emergency medical radio communications. These frequencies (32 in number) are allocated, however, as a part of the "Special Emergency Radio Service" which means that EMS must share with disaster relief agencies, school busses, beach patrols, establishments in isolated areas, and common carrier standby and repair facilities. Additionally, seven pairs of base-mobile frequencies in the 460 MHz band have been provided for ambulance-to-hospital biomedical telemetry systems.

A detailed presentation on frequencies available for EMS purposes is contained in Appendix B. As indicated therein, not only are the EMS frequencies shared with other operations in the "Special Emergency Radio Service", but there are also a number of other limitations. For example, some of the frequencies are subject to a "doughnut rule", i.e., they cannot be used by a station located within 40 miles of other stations; others must receive written clearance from licenses of all stations authorized to operate on a frequency 30 kHz from this frequency within 75 miles of the proposed EMS location. Several of the 30-50 MHz frequencies are shared not only with other "Special Emergency Radio Service Stations" but additionally with stations in the "Highway Maintenance Radio Service."

An analysis of FCC records reveals that there are 11,721 licensees for the 32 frequencies available for EMS communications. One frequency (155.340 MHz) has 1564 licensees for its use, another (155.280 MHz) has 884 licensees. As a national average there are 366.2 licensees per frequency available for EMS use.

As this report is being prepared, the FCC is undertaking Rulemaking action in an attempt to improve the medical paging situation. However, the current picture is that medical paging operations are being authorized as additional operations on some of the EMS frequencies. Thus, an already congested situation is being further aggravated by the superimposition of these tone and voice paging functions. To meet this, the FCC is considering the assignment of separate frequencies for tone paging in the "Special Emergency Radio Service", e.g., 157.450 MHz.[1] (Notice of Proposed Rulemaking in Docket 19643, FCC 72-1040.) Additionally, the FCC has recently allocated four frequencies in the 35-43 MHz band for one-way paging operations in the "Special Emergency Radio Service".[2]

The situation regarding frequencies for biomedical telemetry is brighter. The seven pairs of frequencies in the 460 MHz band have been assigned on virtually an exclusive basis for this purpose. Interference between users

1. There is doubt, however, that 157.450 MHz will be selected as it is in a Worldwide Maritime Mobile Band.
2. First Report and Order, Docket 19327 -- FCC 72508.

within a given area can be complicated. Since the number of telemetry operations is relatively small, this is not a major problem at the present, but will require close coordination as more equipment reaches the field. Sharing within a given area is a complication, but so far this has not proved to be a problem either.As indicated in Appendix B (Table 4C), there is some sharing of these 460 MHz frequencies with other than telemetry functions in the EMS, e.g., dispatching of ambulances and doctor's "talk" circuits.

The analysis made by the members of Ad Hoc 120 indicates that the radio frequency needs of EMS exceed those provided in the FCC Rules and recapitulated in Appendix B hereto. To a great degree, frequency allocations for EMS were made before later transportation and communications technologies made rapid response EMS systems possible. As a result, the present FCC rules do not facilitate systems development or the adoption of new technological advances. Besides the excessive sharing with other functions being involved, present special emergency frequency authorizations do not provide:

-- for relays (except by ambulance relay) of EMS information through strategically located fixed repeaters. Where effective communications cannot be established between an ambulance and a central station, an alternate means is required.

-- for the Fire, Police, and Local Government Radio Services (except for limited authorization in the 460 MHz band), to utilize EMS frequencies in emergency medical situations.

-- for hospital-to-hospital radio communications in EMS situations. Under certain emergency situations, hospital-to-ambulance voice communications as well as hospital-to-hospital communications are needed to coordinate patient care.

-- for an EMS "scene-of-action" or national calling frequency so that EMS vehicles from different jurisdictions can communicate with each other.

-- for the often times particularly different requirements of remote and rural areas. (Often involving mountainous or otherwise hazardous terrain.)

-- for the interface of EMS communications with public service agencies, such as the U.S. Coast Guard that may become involved jointly in emergency medical incidents.

-- for air ambulance operations. There is growing use of air ambulances utilizing both fixed and rotary wing aircraft. These aircraft must operate in the civil air complex and also be able to communicate with the EMS system on the same basis as a ground ambulance.

-- for data telemetry with commentary at VHF.

-- for the use of a collective or joint call sign.

PART IV - EMS RADIO FREQUENCY REQUIREMENTS AND RECOMMENDED ALLOCATIONS

In considering the frequency needs for EMS, it becomes apparent that the crucial matter to observe is that telecommunications provides the means by which the various subsystems of a total EMS are brought together in a coordinated fashion. It might be said that no truly effective EMS can be formed without communications. Although many of the medical functions, ambulances, hospitals, emergency departments may exist and are in place, they have not been systematically related. Telecommunications serves this requirement; although the requirement will vary from community to community, depending on local needs.

Ad Hoc 120 identified the essential elements of a functional EMS as related to both rural and urban EMS population densities. These elements include trained personnel using appropriate diagnostic and therapeutic equipment, acting under remote medical supervision, for on-the-scene treatment (with stabilization of the patient) and, finally, transport of the patient to definitive medical care in a hospital emergency department or a physician's office. It became clear that coordination could best be managed from a centralized regional Resource Coordination Communications (RCC) Center which could receive calls and be responsible for making an appropriate response of resources, acting under medical supervision, for such on-the-scene treatment. The sophisticated requirement of such an RCC could vary depending on the community. For example, in a rural area, it may actually be the "all-night" cafe, the local telephone operator, or the sheriff's home, whereas, in a large city, it may be a complex operation involving many dispatchers and supervisory personnel.

Ad Hoc 120 tried to identify and bring into focus the special characteristics of EMS that distinguish it from the considerations that previously have been given to the Special Emergency Radio Services in general. Two features seemed prominent:

1. The need for frequencies dedicated specifically to EMS because of the critical element of time involved in delivery of life-saving procedures in most emergency medical situations, and

2. The complex interactions of large numbers of people or groups in providing emergency care. In the truest sense, the emergency medical services system becomes a "system" involving a multitude of actions and interactions between the patient, providers, consumers, and political jurisdictions, including the various Federal Government agencies and departments as described in Part I of this paper.

The EMS, while an extension of the usual health delivery system, differs in one important way. The usual direct personal doctor-patient relationship is modified to one in which the patient must be treated by trained paramedical people in the field, operating under remote physician supervision, until the patient is transported to a hospital for comprehensive medical treatment. Communications permits selection of one hospital appropriate to the condition of the patient, while the hospital can be alerted and placed in readiness for the particular case.

Several identifiable functions were found which require frequency allocations beyond those now provided in the Federal Communications Commission (FCC) Rules. The need for Government/non-Government (G/NG) spectrum allocations became obvious. The approach of Ad Hoc 120 was to consider the needs of today--using today's technology, equipment and dollars to implement EMS systems telecommunications that would be viable into the 1980's. Thus, we considered the several functional categories for possible frequency allocations. Although the number of incidents in an urban area generally establishes the number of frequencies required to prevent interference and system saturation, the distance in the rural areas influences the preferred wavelength or frequency. An additional important consequence is the need to continue use of existing communications equipment while developing and implementing the optimum system concepts.

Our concept of operation in the present consideration was that EMS must be planned and implemented at the community level. The community is defined to be the natural catchment area, or area for implementation of a total EMS system which serves the urban and rural population densities in this country. Thus, our planning is conceived of a multitude of self-sufficient EMS communities which join and span a state or several states. We proposed that allocations be made to a community on the basis of an area-wide coordinated implementation plan, using frequency coordinators required to meet the specific system requirements of that geographical area served by the community. Frequency coordination of this type is required to insure the compatibility of all public services.

Thus, we have specified maximum numbers of frequencies on a functional "need" basis, but will leave it to communities to determine operational allocations and frequency utilization within rules and policies that are determined by the FCC and the Office of Telecommunications Policy (OTP). At the same time, we have tried to recognize the need to communicate between resource management centers of adjacent communities in the time of national or other disasters.

Ad Hoc 120 borrowed from the experience of other public-service agencies and the Armed Forces in search and rescue activities to identify requirements for calling and on-scene-of-action frequencies, and a collective call sign. These will provide compatibility between adjacent EMS systems

on a nationwide basis, and also permit communications between agencies responding to emergency situations. This recommendation recognizes the need to relate to other emergency services. Experience has indicated that a common calling or emergency frequency is needed to establish initial contact, with an equally important need for scene-of-action frequencies available to coordinate activities at the scene of an emergency.

Ad Hoc 120 recommends that the following frequencies be made available on an exclusive (o at least on a priority) basis for use by both Government and non-Government (G/NG) interests for EMS functions as indicated and in a manner most appropriate to meet community needs:[1]

1. "National" EMS "common" calling and scene-of-action frequencies:

   155.340 MHz - (15 kHz channel) reallocated from existing hospital routine and administrative communications use; however, hospitals would be qualified to continue to use 155.340 MHz as the new "common". Existing hospital usage would be moved over to another service, e.g., business radio.

   463.175 MHz (25 kHz channel) - Presently unallocated.

2. Paging

   43.64 MHz (20 kHz channel) - Presently a non-Government paging channel.

   152.0075 MHz (15 kHz channel) - Presently a non-Government splinter channel.

   150.775 MHz - Presently Government military.[2]

   150.785 MHz - Presently Government military.[2]

   449.950 MHz (25 kHz channeling) - Government Radiolocation and amateur band.[3]

   449.900 MHz (25 kHz channeling) - Government Radiolocation and amateur band.[3]

   449.850 MHz (25 kHz channeling) - Government Radiolocation and amateur band.[3]

1. To facilitate the administration of the "NG" aspects of EMS telecommunications, it is recommended that the Federal Communications Commission establish an "Emergency Medical Radio Service" that would be similar to and have the same protection as the Police and Fire Radio Services.
2. Limited to use with 5 watts ERP only.
3. Some area restrictions may be required due to existing Government radiolocation operations.

3. Command and Control (including dispatching) to provide communications with the ambulance driver.[1]

   162.6625 MHz - available for use in simplex mode by emergency vehicles eligible for independent use operations. Frequency presently Government non-military.

   453.175 MHz / 458.175 MHz (Paired)* - Reallocate from "call box" in Local Government Service in FCC Rules.

   460.550 MHz / 465.550 MHz (Paired)* - Already assigned in FCC Rules.

   453.025 MHz / 458.025 MHz (Paired)* - Also available for use as "common" working frequencies at a "scene of action". Frequencies already assigned in FCC Rules.

4. Telemetry, Data Handling, and Doctor's Talk Circuits. (For use in ambulance to base (or hospital), and portable EMS units to ambulance or other relay.) (All already assigned FCC Rules.)[1]

   460.525 MHz / 465.525 MHz (Paired)*

   463.00 MHz / 468.00 MHz (Paired)*

* All 25 kHz channels.

1. Emphasis is placed on the use of 450-470 MHz band frequencies for both "command and control" and "telemetry" functions to simplify equipment planning and design of electronic systems for emergency vehicles. Telemetry is already concentrated in this band and represents an expansion upon existing authorizations. Cognizance was taken of the practical fact that in many areas separate ambulance "command and control" and "telemetry" installations would not be required--accordingly use of 450-470 MHz band frequencies permits both the "command and control" and "telemetry" functio to be carried out using a single piece of equipment (e.g., "command and control" on 453.175 MHz and "telemetry" on 458.175 MHz).

   In some areas, particularly rural and mountainous areas, repeaters may be required to assure adequate EMS communication coverage. It is intended that local and/or regional authorities should engineer EMS repeater installations based on their specific requirements using frequencies from among those listed herein for "command and control" and "telemetry" functions.

463.025 MHz / 468.025 MHz (Paired)*

463.050 MHz / 468.050 MHz (Paired)*

463.075 MHz / 468.075 MHz (Paired)*

463.100 MHz / 468.100 MHz (Paired)*

463.150 MHz / 468.150 MHz (Paired)*

463.125 MHz / 468.125 MHz (Paired)*

453.075 MHz / 458.075 MHz (Paired)* - Reallocate from "call-box" in Local Government Service in FCC Rules.

453.125 MHz / 458.125 MHz (Paired)* - Reallocate from "call-box" in Local Government Service in FCC Rules.

* All 25 kHz channels.

5. Hospital to Regional Resource Coordination Communications (RCC) Center (Including hospital-to-hospital)

468.175 MHz (25 kHz channel) - Presently unallocated in FCC Rules.

155.280 (25 kHz channel) - Presently authorized in FCC Rules for hospital-to-hospital communications.

The foregoing radio frequency recommendations are made on the basis of requirements of a major urban area of a population density of eight million people. Statistics used were that: (a) For every million people there would be 200 daily emergency calls for ambulance services or one every seven minutes.[1] (b) Of these calls one-half could be life threatening. Approximately one-fourth would be for cardiovascular emergencies and 20% would be the result of accidental or other trauma. (c) About one-half of the cardiovascular calls would require telemetry, data handling or some professional guidance. (d) The average ambulance run in urban areas varies from 5 to 20 minutes but 30 or more minutes are required in rural areas where 70% of highway deaths occur. (e) In urban areas up to 70% of ambulance runs to major hospital centers will require an emergency admission.[2]

As regards medical paging, the foregoing recommendations are based on providing service to the entire medical community as a part of EMS—the philosophy being that a doctor would not be paged unless it were an emergency of some sort. There are an estimated 400,000 physicians in the USA of which over 300,000 are in active practice. With the present concentration of physicians in urban areas queuing of calls occurs, sometimes with delays of ten to fifteen minutes. The recommendation for paging frequencies is based on a concept that not more than 400 physicians per frequency in any one area would be realistic.

Conceptually, we anticipate that metropolitan areas will find it desirable to separate the following functional activities in terms of frequency utilization: (a) dispatching; (b) medical paging (tone/voice); (c) telemetry and other medically supervised activities; (d) interagency coordination; (e) on-the-scene communication/calling-frequencies; and (f) hospital communications related specifically to EMS. (Note - conceptual diagrams in Appendix A.)

1. Reported for 1971 by New York City Health and Hospitals Corporation, May 1972.
2. Data from EMS Division, Detroit Fire Department and the Detroit General Hospital, June 1973.

We recognize that both municipal and private services must be considered as operational components of such an area-wide EMS system and that appropriate interfaces are made best at the community level. Our planning does not require combination of efforts but does emphasize the need for a coordination of such efforts. Because of the limited number of frequencies that can be made available, coordinated EMS planning and cooperative efforts, based on a systems approach appear to be the best method of proceeding.

The utilization of frequencies for specific activities within a community will be determined after an EMS system is specified for the cities, counties and towns in the catchment area of the community. The attached diagrams present some of the typical frequency utilizations for such systems and show the various configurations possible. Each schematic is intended to present rationale for such a configuration rather than to suggest any one way or another for community planning.

Appendix A contains some illustrations of systems that could be used in a metropolitan area. For these illustrations it is assumed that entry into the "system" will be by telephone (one number, "911", or special) or by other existing communications. The function of resource management then could utilize a combination of telephone, hot line, direct line, microwave or radio. For purposes of discussion, it is assumed in some cases that the Resource Coordination Communications (RCC) Center could be functionally removed from a hospital. In other situations the "hospital" could provide all the required functions.

The dispatching is performed through a base station which dispatches emergency vehicles throughout the area for the area of the EMS. We realize that some private systems will prefer to operate in a one frequency simplex system for shared dispatching with other independent ambulance services or cities in the area. Conceptually, we expect that the large metropolitan areas would have traffic density sufficient to require that the front-end of the vehicle remain "on the dispatch" or "command and control frequency" for continued command and control. It is assumed that specialized needs for on-the-scene activities would require "disaster type of command and control" and that "telemetry" per se would be replaced by on-the-scene physicians with need to communicate as part of a triage function. By selection of a scene-of-action frequency, all mobiles and bases can switch to on-the-scene operations using existing communication equipment.

The command and control function of dispatching on a two-frequency mobile relay configuration would (a) allow units in the field to communicate also in the day-to-day operations, (b) allow routing of vehicles and initiation of a call to begin other than by telephone (hot line) as may be done if the vehicle is at a fixed location, (c) allow the dispatcher

to participate in and be in control of routing to hospitals by providing the communication link to the hospital emergency department, physicians, etc. (This assumes hospital categorization and "physician" supervision of in-the-field units), and (d) assures continued capability to communicate with a vehicle in the field as required in discontinuing a call, etc. In some rural areas with low radio traffic density, the dispatching and medical supervision could be done using one piece of equipment in either a simplex or mobile relay operation.

The interactions and communication between the EMT in the field and the supervising physician and the hospital is more complex but is still processed through the Resource Coordination Communications Center. One of the illustrations in Appendix A shows a full duplex/multiplex system with ambulance repeater as the most likely reliable system for a variety of communications. The base-to-hospital communications are by means of special telephone lines with a simplex hospital link as backup. Medical paging (one-way tone/voice) is shown for the general medical community.

We have assumed that medical supervision for the EMS will be addressed by system planning, as well as system operation, utilizing a physician(s) at the hospital and/or in remote sites in the field (his office, car, home). Physician supervision is a medical-legal requirement in most States. Because of cost and shortage of medical manpower, an EMS can be designed to have console support and strip chart confirmation at a hospital emergency department and/or coronary care unit performed by EMT's or nurses with physician judgement and advice provided at the console and/or from in the field. Conceivably house staff, such as interns and residents, would provide hospital supervision of the system with consultation from the EMS expert physician in the field. Additionally record keeping and data retrieval could be inherent to the system, but will take different configurations based on local requirements and capabilities.

We selected for description a full duplex system (multiplexing ECG and EMT voice) so as to require the minimum number of people for on-the-scene treatment of a patient using cardiopulmonary resuscitation without the requirement for pushing radio switches or holding a handset. Thus, it would be anticipated that one EMT could be totally involved, using both hands in providing assisted breathing (bag-oxygen-tube/face mask) and the other EMT would utilize both hands for external heart massage. Thus one of the EMT's would have on a headset and be engaged in full duplex communication. In order to provide full duplex communication, and in the field communication with a physician, the multiplex signal is retransmitted by the base when the physician or hospital personnel are not talking. Thus, there is full duplex capability, but push-to-talk is required by the physician supervisor. This method also provides for a continuous link so the EMT can hear himself and the ECG tone which is being sent to the physician. The audible tone modulated by the ECG gives him a way to "monitor" the patient continuously at times when the heart is beating.

As described, the hospital or physician in the field has intercept capability (through push to talk) to break in and give directions to the EMT. Similarly, the system affords communication between the hospital and the physician in the field.

It is anticipated that such four channel capability, including telemetry, would be used selectively with cases going to the doctor in the field only if there is no house staff (hence small telemetry load likely on the system) or for specialized cases requiring expert advice of experienced EMS physicians in the field.

Conceptually, the second, third and fourth simultaneous runs would be handled by a different frequency configuration of the EMS. Here we assume that a community large enough to have multiple simultaneous runs will have personnel continually in the hospital. Thus, the personnel in a fixed location may monitor 3 or 4 scopes simultaneously. In order to assure that the incorrect microphone or button is not pushed and advice sent to the wrong EMT's we have depicted only one talk-back frequency for up to 4 simultaneous runs--thus requiring identification of the EMT team in the field.

Using this approach, only one talk-back frequency is required for use of four simultaneous incidents of monitoring from the field; and only one pair of frequencies (portable/ambulance--repeater is required per incident in the field. Obviously, only one frequency is required per incident if a mobile repeater is not utilized.

The UHF link between the portable and the ambulance repeater is selected to maximize reliability of penetration from within a building or other enclosure which isolates a patient. Conceivably a combination of UHF to VHF could be utilized for this part of the system, especially since the numbers of available VHF frequencies are limited. Continued use of the present VHF Band SERS frequencies has not been overlooked. The frequencies will continue to be available for use on their present basis.

Medical paging is performed using one-way communication of tone followed by voice. The large number of physicians in the health delivery system who can be activated or called to an emergency room for continued treatment of the patient or for assembly in times of disaster requires a system which accommodates a large number of users. Thus, talk-back capability (two-way) page is not envisioned. The system depicted allows the day-to-day paging, required by physicians in the hospital or office care of their own patients. Emergency paging is performed on the same link. This assures compatibility with the EMS system and provides day-to-day use and involvement by all physicians.

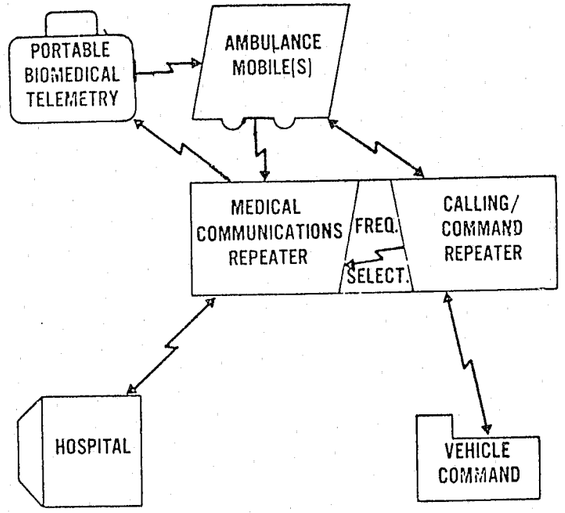
The linkage between hospitals, and from hospitals to the base RCC, is provided by simplex operation on frequencies slightly removed. Special cases which require direct voice communications between persons in any hospital (radio or voice) could be patched at the RCC.

APPENDIX A

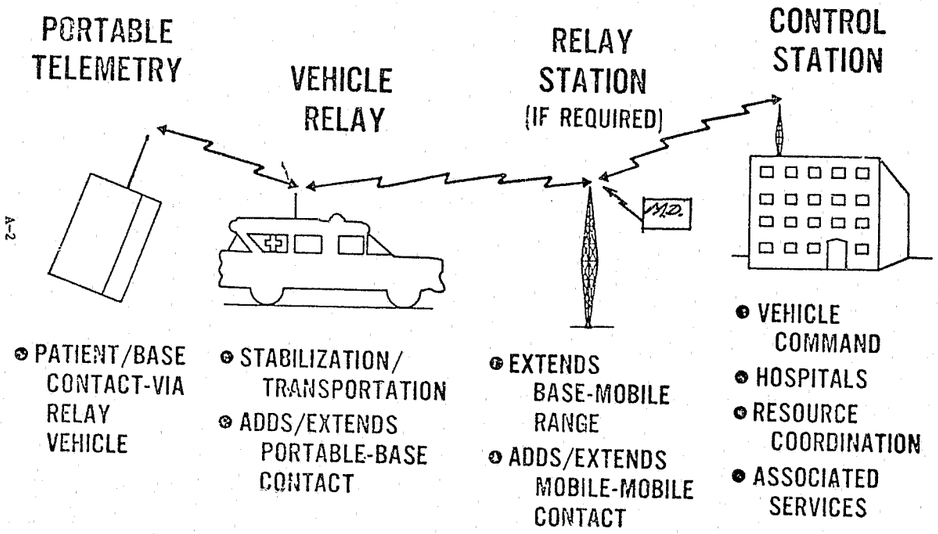
This Appendix contains five diagrams indicating various concepts for basic Emergency Medical Service (EMS) Systems communications. It is anticipated that decisions as to which concept or combination of concepts that would be implemented in a particular state, regional, or local area would be made by the local authorities therein.

Obviously EMS Systems communications can be developed in a variety of ways. The diagrams in this Appendix are intended to illustrate some examples only.

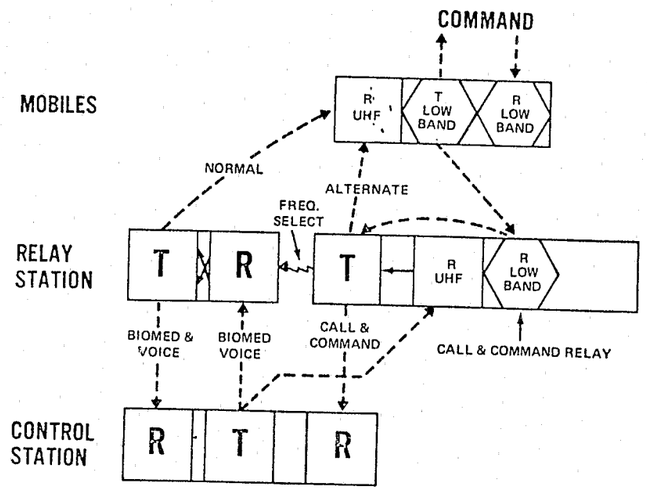
EXAMPLE OF EMS COMMUNICATIONS
FOR
AMBULANCE OPERATION



ELEMENTARY EMS COMMUNICATIONS

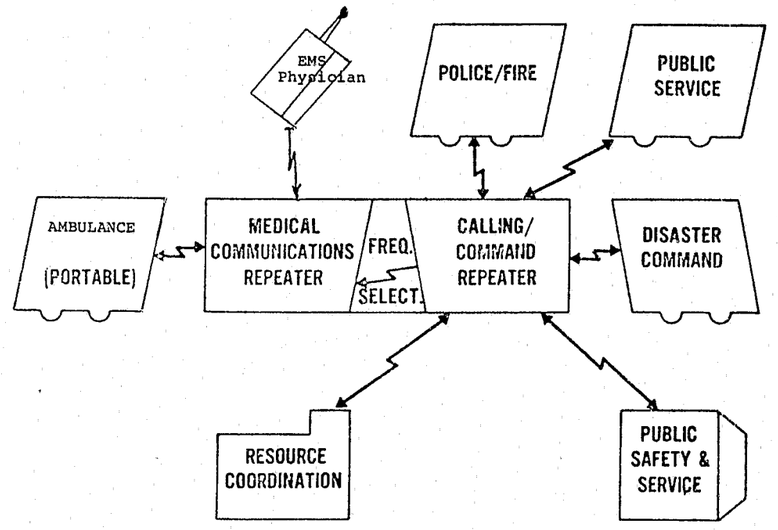


EXAMPLE OF
TRANSITIONAL SYSTEM ACCOMMODATING
LO BAND MOBILES



Requires addition of UHF
Receiver in Mobile

EXAMPLE OF EMS COMMUNICATIONS
FOR
INTERFACE COORDINATION



NOTE: The material in this appendix is quoted from DHEW Publication No. (HSM) 73-2003 of August 1972.

APPENDIX B

Emergency Radio Frequency Assignments

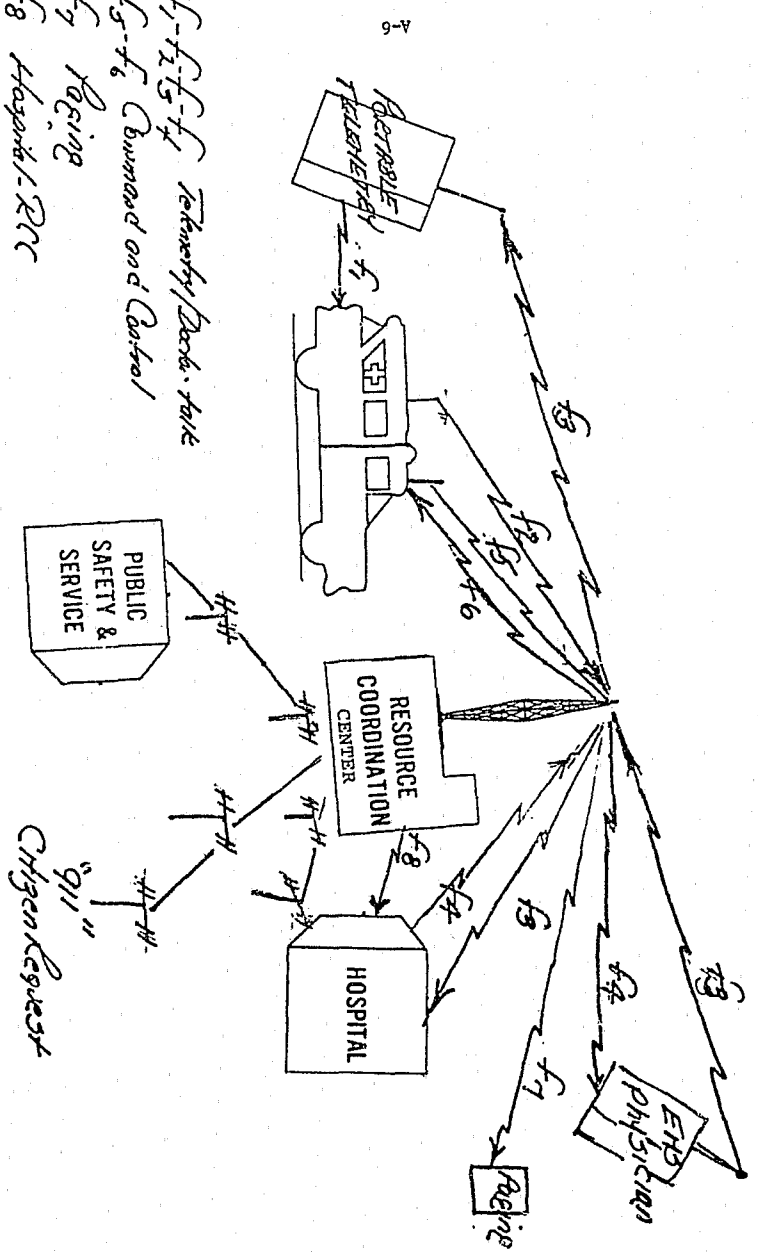
At the present time, except for two frequencies in the Medium Frequency (MF) band, the FCC has set aside VHF band assignments for general emergency medical radio communications and UHF band assignments for ambulance to hospital telemetry systems. Tables 4-A and 4-B show the VHF frequencies which are available to the Special Emergency Radio Service which includes hospitals, ambulance and rescue organizations, physicians and veterinarians, disaster relief agencies, school buses, beach patrols, establishments in isolated areas, and common carrier standby and repair facilities. The UHF frequencies can be assigned for biomedical telemetry operations to eligible licensees in the Fire, Local Government, and Special Emergency Radio Services (hospital, ambulance operators or rescue squads).

The Federal Communications Commission* has provided seven base-mobile frequency pairs in the 460 MHz band for these operations. See Table 4-C. In summarizing the rule changes adopted March 23, 1972 to establish ambulance to hospital biomedical telemetry systems the Commission stated:

> *All of these frequencies are available in the Special Emergency Radio Service. The mobile frequencies are primarily assignable for telemetry transmissions, but supplemental voice operations related to the telemetry activity may also be conducted on mobile frequencies. The five base-designated frequencies 463.000 through 463.100 MHz are assignable for hospital to vehicle voice communications regarding the telemetry activity. They may also be used to accommodate the need for portable telemetering from patients before they can be placed into ambulances to telemeter from the patients through ambulance radios to a hospital (portable to mobile/mobile-relay). The two base-designated frequencies 460.525 and 460.550 MHz are assignable only for central dispatching of ambulance telemetry systems under an area-wide communication plan for coordinated use of telemetry frequencies. They may be assigned in the*

*Federal Communications Commission, Report and Order, Docket No. 19261, released March 29, 1972.

EXAMPLE OF EMS COMMUNICATIONS FOR AN URBAN AREA



Special Emergency and Local Government Radio Services, in addition to the Fire Radio Service, for this purpose. (No other 460 MHz frequency is available for dispatching ambulance telemetry systems.) The two mobile-only frequencies, 465.525 and 465.550 MHz, also are availble under an area-wide communication plan for central dispatching which will permit their use of telemetry when they are needed for the latter purpose. These communications plans may incorporate a single licensee dispatching multiple telemetry systems, or a group of licensees operating independent or shared telemetry systems, or both. The object is to encourage and maximize the most effective use of the limited number of frequencies available for these purposes in a given area.

Permissible Communications

FCC regulations permit the following uses of the frequencies allocated to the special emergency radio service:

Hospitals – Except for test transmissions stations licensed to hospitals may be used only for the transmission of messages necessary for the rendition of an efficient hospital service.

Ambulance Operators and Rescue Organizations – Except for test transmissions stations licensed to ambulance operators or rescue squads may be used only for the transmission of messages pertaining to the safety of life or property and urgent messages necessary for the rendition of an efficient ambulance or emergency rescue service.

Test Transmissions

Tests may be conducted by any licensed station as required for proper station and system maintenance, but such tests shall be kept to a minimum and precautions shall be taken to avoid interference to other stations.

Table 4A
LOW BAND VHF RADIO FREQUENCIES
FCC Allocations – Type Radio Service by Frequency
Limited to those frequencies assigned to the
SPECIAL EMERGENCY RADIO SERVICE (SER)
and adjacent frequencies

FREQUENCY (MHz)	SER with limitations*	OTHER ALLOCATIONS	FREQUENCY (MHz)	SER with limitations*	OTHER ALLOCATIONS
33.00		GOV	46.00	x (3)	
33.02	x (2)	HMR	46.02		PRS
33.04	x		46.04	x (3)	
33.06	x (2)	HMR	46.06		FRS
33.08	x		47.40		HMR
33.10	x (2)	HMR	47.42	x (4)	
33.12		SIR	47.44		SIR
37.88		PwrR	47.46	x	
37.90	x (2)	HMR	47.48		SIR
37.92		HMR	47.50	x	
37.94	x (2)	HMR	47.52		SIR
37.96		HMR	47.54	x	
37.98	x (2)	HMR	47.56		SIR
38.00		GOV	47.58	x	
45.90		PRS	47.60		SIR
45.92	x (3)		47.62	x	
45.94		PRS	47.64		SIR
45.96	x (3)		47.66	x	
45.98		PRS	47.68		SIR

Abbreviations Used:

SER - Special Emergency Radio Service
FRS - Fire Radio Service
GOV - U.S. Government
HMR - Highway Maintenance Radio Service
LGR - Local Government Radio Service
PRS - Police Radio Service
PwrR - Power Radio Service
SIR - Special Industrial Radio Service

Table 4A (Continued)

*Limitations (numbers in parentheses on preceding page are explained)

1. Those frequencies which are not assigned to the Special Emergency Radio Service (SER) are listed because they are possible assignments in neighboring areas which may affect licensing.
2. This frequency is shared with the Highway Maintenance Radio Service.
3. Available for assignment: Provided that until further order of the Federal Communications Commission, application is accompanied by a written and signed statement that licensees of all stations–*excluding Special Emergency stations*–located within the radius of 75 miles of the proposed location, and authorized to operate on a frequency 30 kHz or less removed, have concurred with such assignment, or is accompanied by an acceptable engineering report indicating that harmful interference to the operation of such existing stations will not be caused.
4. This frequency is reserved for assignment only to national organizations established for disaster relief purposes.

Table 4B
HIGH BAND VHF RADIO FREQUENCIES
FCC Allocations – Type Radio Service by Frequency
Limited to those frequencies assigned to the
SPECIAL EMERGENCY RADIO SERVICE (SER)
and adjacent frequencies

FREQUENCY (MHz)	SER with limitations*	OTHER ALLOCATIONS	FREQUENCY (MHz)	SER with limitations*	OTHER ALLOCATIONS
155.130		PRS	155.295	x (3)	
155.145		LGR	155.310		PRS
155.160	x (2)		155.325	x (3), (4)	
155.175	x (3)		155.340	x (2), (4)	
155.190		PRS	155.355	x (3), (4)	
155.205	x (3)		155.370		PRS
155.220	x (2)		155.385	x (3), (4)	
155.235	x (3)		155.400	x (2), (4)	
155.250		PRS	155.415		PRS
155.265	x (3)		155.430		PRS
155.280	x (2)				

Table 4B (Continued)

Abbreviations Used:

SER - Special Emergency Radio Service	LGR - Local Government Radio Service
FRS - Fire Radio Service	PRS - Police Radio Service
GOV - U.S. Government	PwrR - Power Radio Service
HMR - Highway Maintenance Radio Service	SIR - Special Industrial Radio Service

*Limitations (numbers in parentheses above are explained)

1. Those frequencies which are not assigned to the Special Emergency Radio Service (SER) are listed because they are possible assignments in neighboring areas which may affect licensing.
2. Applications for assignment (a) should be accompanied by a written and signed statement that licensees of all stations, authorized to operate on a frequency 30 kHz or less removed (except Special Emergency stations) within 75 miles of the proposed location, have concurred with such assignment; or (b) is accompanied by an acceptable engineering report that harmful interference to the operation of existing stations will not be caused.
3. Available for developmental operation if (a) the proposed station is located at least 40 miles from all other stations except authorized Special Emergency licensees on frequencies 30 kHz or less removed; (b) includes with the application a written and signed statement that the licensees of all stations except Special Emergency stations within 75 miles of the proposed location authorized to operate on a frequency 30 kHz or less removed, have concurred with such assignment; or (c) includes an acceptable engineering report that harmful interference will not affect the operation of existing stations (except Special Emergency stations) within the 75 mile radius; and (d) provides a written statement that licensees of all stations described in (c) have been notified of the applicant's request for the frequency assignment.
4. Available for assignment only to hospitals (institutions or establishments offering services, facilities, and beds for use beyond 24 hours in rendering medical treatment) and to those ambulances which submit a showing that they render coordination and cooperation with a hospital authorized on this frequency.

Table 4C
UHF BAND RADIO FREQUENCIES
FCC Allocations – Type Radio Service by Frequency
Limited to those frequencies assigned to the
SPECIAL EMERGENCY RADIO SERVICE (SER)
for Bio-Medical Telemetry

FREQUENCY (MHz)	Class of Station(s) with Limitations*	FREQUENCY (MHz)	Class of Station(s) with Limitations
460.525	Base & Mobile (1), (2)	465.525	Mobile only (1), (5)
460.550	Base & Mobile (1), (2)	465.550	Mobile only (1), (5)
463.000	Base & Mobile (1), (3)	468.000	Mobile only (1), (4), (6)
463.025	Base & Mobile (1), (3)	468.025	Mobile only (1), (4), (6)
463.050	Base & Mobile (1), (3)	468.050	Mobile only (1), (4), (6)
463.075	Base & Mobile (1), (3)	468.075	Mobile only (1), (4), (6)
463.100	Base & Mobile (1), (3)	468.100	Mobile only (1), (4), (6)

*Limitations (numbers in parentheses above are explained)

1. For two frequency systems, separation between base and mobile transmission frequencies is 5 MHz.
2. The frequency may be assigned (a) to dispatch ambulances and personnel operating bio-medical telemetry units under an area-wide radio communications plan; and (b) is available also for this purpose in the Fire and Local Government Radio Services.
3. This frequency is available for assignment to hospitals (institutions or establishments offering services, facilities, and beds for use beyond 24 hours in rendering medical treatment) for communication with medical care vehicles and personnel equipped with bio-medical telemetry capability. Use of this frequency is further authorized for telemetry or voice transmissions from a portable telemetering unit to an ambulance for automatic retransmission (mobile/relay) from a patient to a hospital or other medical care facility. When using telemetry emission, the continuous carrier mode of operation is authorized for this frequency.
4. This frequency is available for assignment to operate mobile bio-medical telemetry units in ambulances and other medical care vehicles, or when hand-carried by medical personnel. Telemetry transmission may be authorized,. Voice transmission may also be authorized on a secondary basis when required for the telemetering activity. When using telemetry emission, the continuous carrier mode of operation is authorized for this frequency.

Table 4C (Continued)

5. This frequency may be assigned primarily for mobile dispatch response by ambulance and personnel operating bio-medical telemetry units in this service under an area-wide radio communications plan involving central dispatching on the associated base-mobile frequency 460.525 or 460.550 MHz. When authorized for this dispatch response purpose, this frequency may be used on a secondary basis for the purposes and in the manner set forth in limitations (1), (4), and (6).
6. Mobile stations authorized to operate on this frequency may be used to extend the range of transmission between portable telemetering units and hospitals or other medical care facilities. Each mobile station used for this purpose shall be so designed and installed that it will be activated only by means of a continuous tone device, the absence of which will deactivate the mobile transmitter. The continuous tone device is not required when the mobile station is equipped with a switch that must be activated to change the mobile unit to the automatic mode.

Available Equipment

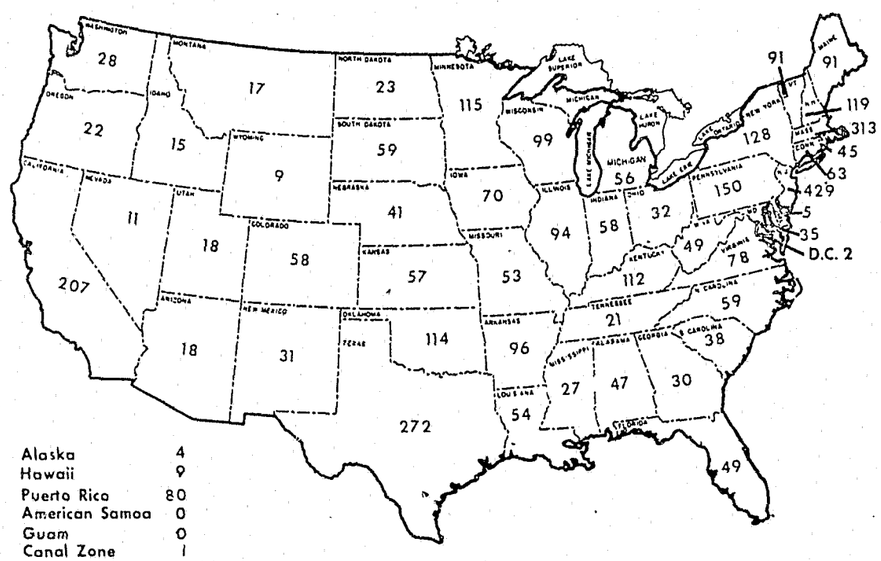
Manufacturers offer communications components for land mobile radio service which have common characteristics: virtually all use frequency modulation (FM) and all are almost completely solid state. (Transistors and Integrated Circuits (IC) are used wherever possible).

The specifications are very similar. Practically all of this equipment exceeds the standards established by the Electronic Industries Association (EIA). Representative comparisons between the standards and manufacturers' specifications are shown in Table 5.

END

STATE & LOCAL EMERGENCY OPERATING CENTERS
COMPLETED AND IN PROCESS

3,803



Alaska	4
Hawaii	9
Puerto Rico	80
American Samoa	0
Guam	0
Canal Zone	1
Virgin Islands	1

SEPTEMBER 30, 1972