



Standard Guide for Emergency Medical Services System (EMSS) Telecommunications¹

This standard is issued under the fixed designation F 1220; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers telecommunications practices and performance standards required to support all of the functions of community EMSS on a statewide basis. It defines state planning goals and objectives for EMSS communications.

1.2 This guide is for planning, coordinating, integrating, and evaluating telecommunications resources statewide to satisfy the functional needs of comprehensive community EMSS systems.

1.3 To facilitate a two-tiered planning approach recommended for EMSS communications, this guide identifies those communications system features that should be coordinated on a statewide basis and defined in statewide (first tier) EMSS communications planning guidelines. Local (second tier) EMSS communications plans prepared in accordance with the statewide guidelines should then be tailored to satisfy local EMSS needs while providing compatibility and interoperability of communications with other EMSS.

1.4 The sections in this guide appear in the following sequence:

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1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- F 1031 Practice for Training the Emergency Medical Technician (Basic)²
- F 1149 Practice for Qualifications, Responsibilities, and Authority of Individuals and Institutions Providing Medical Direction of Emergency Medical Services²
- F 1221 Guide for Interagency Information Exchange²
- F 1229 Guide for Establishing the Qualifications, Education, and Training of EMS, Air-Medical Patient Care Providers²
- F 1254 Guide for Training Emergency Medical Services Ambulance Operators²
- F 1258 Practice for Emergency Medical Dispatch²
- F 1287 Guide for Scope of Performance of First Responders Who Provide Emergency Medical Care²
- F 1381 Guide for Planning and Developing 9-1-1 Enhanced Telephone Systems²

¹ This guide is under the jurisdiction of ASTM Committee F-30 on Emergency Medical Services and is the direct responsibility of Subcommittee F30.04 on Communications.

Current edition approved Oct. 10, 1995. Published February 1996. Originally published as F 1220 – 89. Last previous edition F 1220 – 89.

² *Annual Book of ASTM Standards*, Vol 13.01.

F 1418 Guide for Training the Emergency Medical Technician (Basic) in Roles and Responsibilities.²

F 1453 Guide for Training and Evaluation of First Responders Who Provide Emergency Medical Care²

F 1517 Guide for Scope of Performance of Emergency Medical Services Ambulance Operations²

F 1552 Guide for Training, Instructor Qualification, and Certification Eligibility of Emergency Medical Dispatchers²

F 1560 Practice for Emergency Medical Dispatch Management²

2.2 Federal Standards:

Communications Act of 1934 (47 U.S.C. 405) (as amended)³

Title 47, United States Code of Federal Regulations (47 CFR) on Telecommunications³

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *goal*—a statement of broad direction, general purpose, or intent. A goal is general and timeless and is not concerned with a specific achievement within a given time period.

3.1.2 *objective*—a statement of desired accomplishment that can be measured within a specified time frame and under determinable conditions. The attainment of an objective moves the system toward a directly related goal.

3.1.3 Communications terminology used in this guide and references are defined in Appendix X1, Acronyms and Glossary for Emergency Medical Services Systems Communications.

4. Summary of Guide

4.1 This guide identifies the functions and requirements of EMSS telecommunications. Observance of the state EMSS communications planning goals and objectives contained in this guide permits planning and implementation of compatible, interoperable, and reliable local EMSS communications which meet local needs while not interfering with the needs of adjoining EMSS.

4.2 EMSS communications should satisfy all of the performance goals and objectives specified by those who use it and those who are served by it. However, many constraints such as costs, political, demographic and social preferences, existing legislation and time, limit what can be achieved.

5. Significance and Use

5.1 In situations where the coordination of EMSS communications among political subdivisions affects the health and safety of the state's population, it is appropriate for state government to take a coordinating role. Statewide planning for coordinated use of radio frequencies for EMS communications is specifically needed.

5.2 The state is the logical unit to formulate the statutory and regulatory framework for EMSS planning. State planning for area-wide EMSS communications provides authority to

accomplish coordination in the use of available radio frequencies, thus promoting multiagency cooperation to best serve the public needs.

5.3 With statewide planning, communities, counties, and multicounty EMSS regions are provided with guidance to achieve the performance goals and objectives of their EMSS communications systems.

5.4 The statewide EMSS communications performance goals and objectives in Sections 10-15 address specific roles of state governments in EMSS communications systems planning. These performance goals and objectives should be considered by states for evaluating, planning, and implementing of acceptable EMSS communications statewide.

6. Functions and Categories of EMSS Communications

6.1 *Telecommunications Functions*—The report "Communications in Support of Emergency Medical Services," given in Ref (1),⁴ defines the following EMSS functions which require telecommunications:

6.1.1 Medical emergencies requiring EMSS response should be reported immediately to appropriate community agencies that manage and control EMSS resources and services.

6.1.2 Appropriate EMSS resources should respond to human health emergencies at any time and place.

6.1.3 Recognition of the need for and immediate response by EMSS resources to life threatening and serious injuries and illness should be provided within a time period that will ensure the greatest saving of lives and reduction of morbidity.

6.1.4 EMSS and other health agencies and professionals should marshal their individual and collective resources (staff, equipment, supplies, and facilities) and coordinate their responses in the shortest effective time to meet individual and mass medical emergency needs.

6.1.5 Emergency medical dispatchers should have special training to provide guidance and direction to persons at the scene of a medical emergency pending arrival of trained prehospital EMS personnel.

6.1.6 EMSS must be coordinated with other community public safety emergency response services.

6.1.7 The use of EMSS facilities (emergency departments, intensive care, and coronary care units, burn and trauma facilities, etc.) should be coordinated so as to avoid preventable delays in access to definitive emergency medical care.

6.1.8 For life threatening and serious medical emergencies and in other instances requiring invasive prehospital emergency medical care, appropriate physiological data and patient assessment information should be collected and transmitted from the site of the emergency to the EMSS facility providing on-line medical direction.

6.1.9 Telecommunications relating to EMSS should be recorded, documented, saved, and used by EMSS managers to review, evaluate, revise, and reorganize EMSS as necessary to meet changing conditions and needs.

6.1.10 Telecommunications should exist between EMSS facilities and transport vehicles for safe interhospital transfer of

³ Available from Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

⁴ The boldface numbers in parentheses refer to the references at the end of this guide.

patients with life threatening and serious medical emergencies.

6.1.11 Telecommunications should be used as needed, to improve utilization of all EMSS resources and to prevent or mitigate adverse effects of medical emergencies.

6.2 *Telecommunications Categories*—Based on the above EMSS needs, the following categories of information exchange requiring telecommunications are defined in Ref (1) as being necessary to support of EMSS operations.

6.2.1 *EMSS Access*—Exchanges of information related to public access for reporting emergency medical situations to appropriate EMS response organizations.

6.2.2 *EMSS Dispatch and Control*—Exchanges of information related to reducing response time, such as alerting, dispatching, and controlling the movement of EMS vehicles.

6.2.3 *Medical Coordination/Direction*—Exchanges of information related to the emergency patient and his care, such as transmission of physiological information and exchange of patient assessment information and treatment information between EMS personnel at the scene and physicians providing on-line medical direction.

6.2.4 *EMSS Resource Coordination*—Exchanges of information necessary for the effective coordination of all EMS resources.

6.2.5 *Interservice Coordination*—Exchanges of information for coordination of EMS activities with police, fire, government agencies, and other resources, such as public utilities and private contractors.

6.2.6 *Disaster Coordination*—Exchanges of information related to the coordination of EMS activities with those of local, state, and national disaster response authorities.

7. EMSS Functional Communications Requirements

7.1 An EMSS Communications system should provide the means by which emergency resources can be accessed, mobilized, managed, and coordinated. To accomplish this, a communications system must incorporate operational provisions to employ sufficient wire-line and radio linkages and channels among all EMSS participants over the service area of the EMSS (and for disaster response, between EMSS service areas) to facilitate the EMSS functional needs described in 7.2 through 7.5 for communications.

7.2 Citizen Access:

7.2.1 The EMSS communications system should have the ability to receive and process any incoming calls that report emergencies and request emergency medical assistance. Persons should be able to summon help rapidly in an emergency situation. They should be able to call for police, fire, rescue, and other emergency aid promptly, without confusion, and without familiarity with a particular community. Local, statewide, and nationwide uniformity is needed to accomplish this objective.

7.2.2 For several years, numerous governmental commissions, legislative bodies, private organizations, and citizen groups have recommended the establishment of a single, universal “National 9-1-1 Emergency Telephone Number” to meet this need for improved emergency communications. The achievement of this recommendation was stated as a matter of national policy in Bulletin No. 73-1 “National Policy for Emergency Telephone Number ‘911’” issued by the Ex-

ecutive Office of the President on March 21, 1973. The “nine-one-one” concept provides a single number that is easy to use and remember. Moreover, implementation of the three-digit emergency telephone number 9-1-1, encourages coordinated efforts between those providing communications services and emergency responses. The 9-1-1 concept should be included in EMSS communication planning with other methods of citizen access, primarily for its impact on response time and enhanced coordination among participants. Citizen access communications, primarily uses telephones, both public and private, to call 9-1-1 Public Safety Answering Points (PSAP).

7.2.3 On the nation’s highways, citizen access to EMSS is facilitated by use of mobile communications services that enable drivers to rapidly report observed motor vehicle accidents and other emergency conditions to public safety service providers. In areas having cellular telephone coverage, motor vehicle occupants with cellular telephone may make direct calls to the local 9-1-1 PSAP. This use of cellular telephone for accessing public safety services is being facilitated through rule changes initiated in 1994 by provisions of the Federal Communications Commission Rules under RM-8143 Docket No. 94-102; to ensure compatibility of cellular 9-1-1 calls with enhanced 911 emergency calling systems. Also, Citizen Band (CB) mobile radio operators can report observed emergencies to volunteer CB base station radio monitors who in turn relay the information to appropriate public safety response agencies via the 9-1-1 emergency telephone number or some other prearranged telephone number. Similarly, mobile equipped amateur radio operators can report observed emergencies to appropriate public safety authorities via the 9-1-1 emergency telephone number using amateur radio/telephone interconnect services. Finally, motorists not equipped with mobile radio communications, can report emergencies by stopping at the nearest roadside site having a public telephone and dialing 9-1-1. In some locations, a statewide toll-free 800 telephone access number is available for calling state police. The availability of such 800 service should be indicated by road signs. Such 800 calls may also be made via cellular radio. Calls received by the state police may be transferred to the appropriate 9-1-1 answering point or directly to the designated response agency. The use of these numbers should include provisions for assuring caller identification and location and special screening by trained PSAP communicators.

7.2.4 In areas where the 9-1-1 system has not been implemented, citizens may have to search through telephone directories for one of several listed police, fire, ambulance, and hospital emergency room numbers when a medical emergency arises. Continuation of this practice delays the availability of emergency medical assistance and, in life threatening and serious medical emergencies, can cost lives and limbs. There is no technical reason why a basic or enhanced 9-1-1 emergency telephone number cannot be planned and implemented by any telephone company in the United States. The universal “National 9-1-1 Emergency Telephone Number” should be implemented without further delay as a matter of national public safety.

7.2.5 Telephone calls for emergency services made by unattended automatic telephone calling devices should be

received and screened by a private answering service and shall not be dialed in directly to the primary 9-1-1 or other general public access number.

7.3 EMSS Vehicle Dispatch and Coordination—When notified of the need for an emergency medical response, the communications system is used by trained emergency medical dispatchers:

7.3.1 To interrogate emergency callers to determine the nature and severity of the medical emergency,

7.3.2 To provide on-site callers with pre-arrival instructions,

7.3.3 To promptly dispatch the most appropriate EMS vehicles to the site of the emergency,

7.3.4 To guide them directly to the site with minimum delays,

7.3.5 To direct them to an appropriate emergency medical facility, and

7.3.6 To ensure that they become available for further assignment as soon as possible.

7.3.7 While EMS vehicles are enroute to a patient, the communications system is used to keep them informed regarding access to the patient and patient condition.

7.4 Medical Coordination/Direction—The EMSS communications system should provide EMS field personnel with a channel of communications that permits the exchange of treatment information with an EMSS hospital, while at the scene of the medical emergency, in an EMS ambulance and while enroute to an EMS hospital. Such communications also serves to alert the receiving medical facility prior to the patient's arrival, and to provide for coordination between medical facilities. In areas where the need frequently arises, consideration should be given to equipping EMS ambulances with high-power portable radios or vehicular relay equipment and hand-held portables to permit the exchange of patient treatment information while away from an EMS ambulance. Guidelines for medical coordination/direction are contained in Practice F 1149.

7.5 Interservice Communications—Medical emergencies often involve the response of other public safety and emergency services. Interservice communications are needed to support daily EMSS operations and mutual aid agreements, and for mobilization, command, and control of all emergency response units during a disaster situation. Although the various services generally operate on different radio frequencies, interservice radio communications can be provided by use of mobile relays, cross-band operations, cross-frequency patching at the radio consoles, interservice use of common radio frequencies, trunked radio services, or other measures. Telephone lines between communications control centers for various emergency response agencies can also be used for interservice coordination. Provisions for such interservice radio communications should be included in the system design.

8. Radio Frequency Spectrum and Service Requirements

8.1 Radio Frequencies—All nonfederal telecommunications systems in the United States are subject to the regulations of the Federal Communications Commission (FCC). There are radio frequencies nationally allocated primarily for dispatch of ground emergency medical vehicles, transport of patients, and other EMS-related communications. Such radio communica-

tions are allowed under FCC Rules and Regulations (47 CFR, Part 90) Private Land Mobile Radio Services, Subpart B, Public Safety Radio Services. These current FCC Rules clearly distinguish between emergency medical service communications, other types of medical communications, and other types of emergency communications. Section 90.27 of the FCC Rules, defines the Emergency Medical Radio Services (EMRS), and allocates radio frequencies exclusively for licensing eligible applicants to use for EMS communications. FCC Rules and Regulations also permit EMS use of radio frequencies allocated to other land mobile services such as the Special Emergency Radio Service, Local Government Radio Service; Law Enforcement Radio Service; Fire Radio Service; and Business Radio Service.

8.1.1 Radio Frequencies for EMSS Communications—Section 90.27 of the FCC Rules identifies users eligible for licensing on frequencies allocated for EMRS.

8.1.2 Eligibility Criteria—As stated in the FCC Rules, the following are eligible for licensing to use the radio frequency spectrum allocated by the FCC for the Emergency Medical Radio Service: “Persons or entities engaged in the provision of basic or advanced life support services on an ongoing basis are eligible ... to operate stations for transmission of communications essential for the delivery or rendition of emergency medical services for the provision of basic or advanced life support”. EMRS applicants are also eligible for licensing to use frequencies in the Special Emergency Radio Service (SERS): “in order to interface with other entities using SERS channels and to conduct necessary non-emergency communications”.⁵

8.2 EMSS Radio Service Coverage—This guide addresses radio frequencies and radio service coverage currently authorized and available under FCC Rules for use for land mobile communications for EMSS. In the Emergency Medical Radio Service there are seven high band VHF frequencies, five 220 MHz frequency pairs, and thirty-five UHF band frequency pairs. Many of these frequencies are restricted for specific uses, such as paging, inter-system use, medical coordination, vehicle coordination, or shared with other Public Safety Radio Services. Appendix X1 lists the frequencies and usage limitations. While there are no 800 MHz band frequencies specifically allocated to EMS, all EMRS eligible may license 800 MHz frequencies allocated for Public Safety Radio Services. In addition, there are other land mobile communications services such as cellular systems, citizen band radio, and prospective satellite relayed land mobile radio communications systems that are available for public use. It is not intended that this guide exclude EMSS usage of such communications systems. In 1987, The FCC Report on Docket No. 87-112 points out however, that such public communications systems which are merely extensions of the public telephone net, are not amenable to planned usage for public safety services. The usage of any available radio spectrum for EMSS communications should be based on the capability of such systems of communications to provide the necessary linkage to satisfy criteria with respect to reliability of coverage of the EMSS operating

⁵ Summary of FCC Report and Order, PR Docket No. 91-72, *Federal Register*, March 3, 1993.

area, grade of service (probability of blockage and delay) and accountability, that apply to EMSS communications as well as to other public safety communications such as fire and law enforcement communications.

8.2.1 Radio frequencies listed in Appendix X1, and currently available for EMSS communications are in the VHF “low band” (33–48 MHz), the VHF “high band” (150–173 MHz), the UHF band (453–468 MHz) and in the 800 MHz frequency range. The VHF high band and the UHF frequency bands, which are most commonly used for EMS communications, and the 800 MHz frequencies are line-of-sight, with communications range primarily a function of transmitter power output, antenna gain, antenna height and terrain. For planning purposes, estimates of the geographic area over which intelligible voice radio reception can be achieved between a specific radio base station site and a vehicle equipped with mobile radio can be made using computerized communications model services such as those described in Ref (2).

8.2.2 Preinstallation estimates of radio geographic coverage should be verified by post-installation field tests using operational communications equipment. It is important to ensure that the transmitted signal strength from EMSS communications base stations is adequate to provide good radio reception in EMSS ambulances and other response vehicles over the entire area services by an EMSS.

8.2.3 A single radio base station operating on a specific radio frequency channel or channel pair, permits separate two-way communications with a single radio-equipped EMSS ambulance operating on the same radio frequency channel or channel pair. If the need exists to communicate separately with multiple EMSS mobile units simultaneously, then base station sites must be equipped with multiple radio transmitter/receivers each equipped to operate on a separate radio frequency. To communicate by radio in an area provided with multiple transmitter/receivers, and EMSS mobile unit must use a radio transmitter/receiver that can be adjusted to operate on any base station frequency that may be available at a given time.

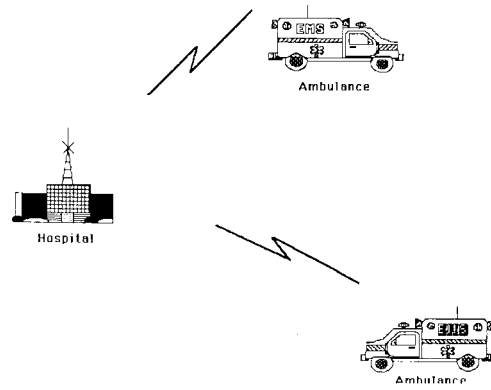
8.2.3.1 Specific estimates of radio frequency requirements to support EMSS communications demands for large populations are contained in Ref (3). Guidelines for determining the number of base station radio transmitter/receivers and radio frequencies needed to assure reliable EMSS communications in support of the EMS demands of various populations will be set forth in a future ASTM standard guide.

8.2.3.2 In instances of mass casualty response, when the need exists for an EMSS base station to communicate the same information to several ambulances; the ambulances involved should all be directed to adjust their radio equipment for operation on the selected base station frequency and to respond in sequence as required. Usage of radio frequencies can thereby be expanded to satisfy mass casualty and disaster EMS communications needs.

8.2.4 Geographic coverage and control for EMSS radio communications can be provided by various communication subsystem arrangements as illustrated in Figs. 1-4.

8.3 Operational Considerations:

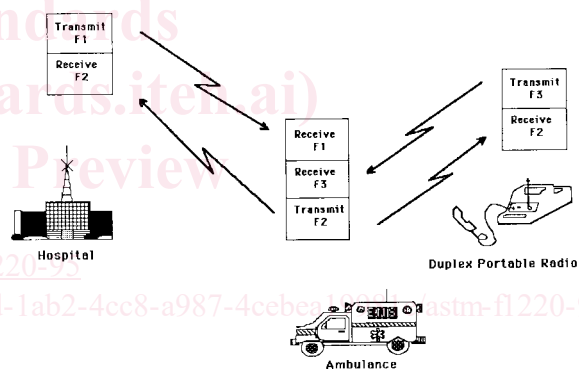
8.3.1 Statewide communications planning, including inter-



NOTE 1—FCC Definitions (47 C.F.R. Sec. 90.7):
mobile station—a station in the mobile service intended to be used while in motion or during halts at unspecified points. This includes hand carried transmitters.
base station—a station at a specified site authorized to communicate with mobile stations.
mobile service—a service of radiocommunication between mobile and base stations, or between mobile stations.

NOTE 2—EMTs in ambulances equipped as “mobile stations” conduct two-way radio communications directly with medical control personnel at EMSS resource hospitals equipped as “base stations.”

FIG. 1 An EMS Base/Mobile Communications System



NOTE 1—FCC Definitions (47 C.F.R. Sec. 90.7):
mobile repeater station—a mobile station authorized to retransmit automatically on a mobile service frequency, communications to or from hand-carried transmitters.
hand carried transmitters—See definition of *mobile station* under Fig. 1 Fig. 1.

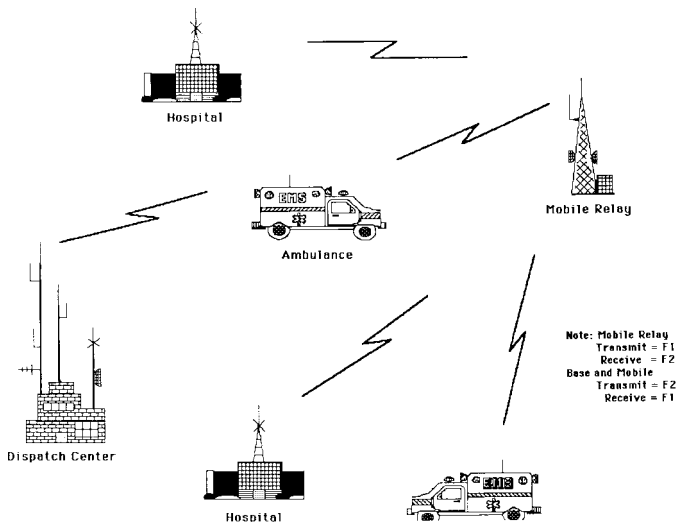
mobile service—See definition under Fig. 1 Fig. 1
portable radio—Syn. for *hand carried transmitter*.

NOTE 2—An EMT equipped with a “hand carried” (portable) duplex radio, while located outside of an ambulance equipped as a duplex “mobile repeater station” can conduct two-way radio communications via the ambulance, with medical control personnel at EMSS resource hospitals equipped as “base stations.” This extends the range of on-line medical control communications for patients outside of, but within portable radio communications range of, an ambulance.

FIG. 2 Extending the Range of Communications for EMTs While Outside of an Ambulance—Typical Both-Way Vehicular Repeater

state, regional and local planning, is essential to successful EMSS operation. EMSS operational control should be carefully established and supported with communications operational procedures.

8.3.2 EMSS communications systems should be planned and operated so as to be compatible and not interfere with the



NOTE 1—FCC Definition (47 C.F.R. Sec. 90.7):
mobile relay station—a base station in the mobile service authorized to retransmit automatically on a mobile service frequency, communications which originate on the transmitting frequency of the mobile station.

NOTE 2—*Mobile Relay*:

Transmit = F1.
 Receive = F2.

Base and Mobile:

Transmit = F2.
 Receive = F1.

NOTE 3—A “mobile relay” located at a remote location can extend the area and range of coverage for both dispatch and medical control communications.

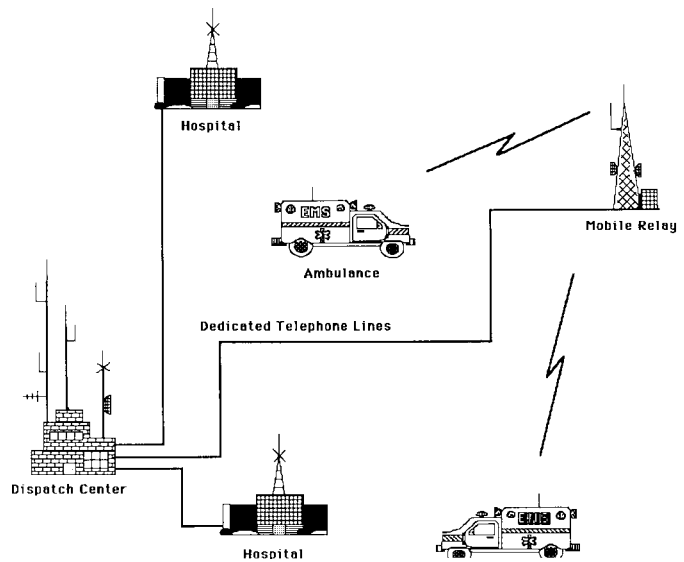
FIG. 3 Extending the Area and Range of Coverage for EMSS Communications Between Ambulances, Hospitals, and a Dispatch Center

communications of adjacent EMSS. Compatibility means that EMS vehicles from one community can communicate with EMS vehicles and EMSS facilities in surrounding communities. Communications compatibility of EMS vehicles is needed for day to day EMSS activities and EMS response to disaster situations. EMSS communications goals, objectives, and planning guidelines that follow are derived from Refs (4), (5), and (6).

9. Goals and Objectives for EMSS Communications

9.1 Determination of state goals and objectives require a definition of the specific role of state government in EMSS communications in its jurisdiction and in boundary areas with adjacent states. In general, state governments do not own or operate EMSS communications systems and do not exercise control over local systems. Instead, state governments act more in the role of planners, coordinators, regulators, and facilitators.

9.2 A state can be thought of as divided into a number of local EMS communications systems. The state’s primary concern is with the external interfaces and interactions of these local EMS communications systems with each other and with their environments. The state government is not so much concerned with the other details of the design and operation of the individual local systems. Following is a description and comments on some of the important interfaces and relationships.



NOTE 1—FCC Definitions (47 C.F.R. Sec. 90.7):
land mobile radio system—a regularly interacting group of base, mobile, and associated control and fixed relay stations intended to provide land mobile communications service over a single area of operation.

land mobile radio service—mobile service between base stations and land mobile stations, or between land mobile stations.

NOTE 2—Real-time centralized coordination/control of base station and mobile relay frequencies and operations in an EMSS “land mobile radio” can be accomplished by use of dedicated telephone lines, microwave links, or combinations of both. In this illustration, the Dispatch Center also serves as the EMSS communications control center.

FIG. 4 Centralized Control of Radio Communications in an EMSS Land Mobile Radio System

9.3 The most important interface is the one between a local EMS communications system and the population it serves. Here, the concern of the state government should be that the system serves its intended functions. The focus is on the end results: the character, quantity, and quality of service provided to the population, rather than the mechanics of how the service is provided. Items of interest include the degree to which the communications system supports the medical requirements for basic life support or advanced life support, communications parameters such as probability of place and time of coverage, communications practices, and operator training standards.

9.4 The second level of interface is between a local EMS communications system and other EMSS communications systems in neighboring areas. There are two main concerns. First, as a minimum, the various communications systems should not interfere with each other. This requires consideration of coverage boundaries, fixed allocation of unique frequencies, and real-time coordination and sharing of common frequencies. Second, systems should be able to cooperate constructively with each other in such matters as point-to-point communications and communications within an area to mobile units passing through from other regions. Items such as voice brevity codes and language must be standardized between regions.

9.5 A third level of interface is between a local EMS communications system and other types of emergency communications systems, such as law enforcement, and emergency

management and fire services, within the same area and with neighboring areas. The concerns are again the avoidance of interference (such as at shared radio sites) and assurance of compatibility for multiagency operations. With the creation of the Emergency Medical Radio Service, EMS agencies maintain their eligibility in the Special Emergency Radio Service (SERS). For EMS communications using frequencies in the SERS, there is a concern for interference from school bus radio communications and from hospital, veterinary and physician business communications that are permitted by the FCC. A “frequency coordination” process must be carried out as part of the statewide EMS communications system planning process to lessen instances of this interference potential.

9.6 A fourth interface is from the local communications system to the state government. The primary concern of the state is in ensuring that its population receives timely and appropriate emergency medical care in accordance with state statutes and regulations and health care standards. Additional concerns are efficient and effective use by the local systems of resources provided by the state or otherwise shared in common with multiple users. These might include radio sites, statewide microwave and telephone systems, and various services such as maintenance and purchasing. Complaints from adjoining states concerning radio communications interference in boundary areas should also be the concern of state government.

9.7 A fifth interface is from the state to the federal government. The state acts as a representative of local EMSS in dealing with federal agencies and other national organizations.

9.8 Finally, the state must be concerned with management of the state-level program. The management functions include ongoing planning; state and upper-level regional organizations; personnel qualifications, standards, and training; direction of the program by laws, rules, funding incentives, other means; and control of the program by means of information feedback, analysis, evaluation, and corrective action.

9.9 In summary, therefore, the areas of concern for definition of statewide goals and objectives are as follows:

- 9.9.1 Functional performance standards,
- 9.9.2 Interface with other EMS systems,
- 9.9.3 Interface with other types of systems,
- 9.9.4 Utilization of state and common resources,
- 9.9.5 National representation, and
- 9.9.6 State level management.

9.10 Each of these areas is addressed as a separate goal in the remaining sections of this guide. Each goal is followed by a listing of specific related objectives and a discussion of the implications of each objective. It should be noted that progress can be made in many of these areas without substantial costs. In other cases, the achievement of certain objectives will involve substantial costs, and therefore, given the national and state economies, those objectives must be considered long term.

10. Goal 1—State EMSS Communication Systems Should Meet Recognized Standards for Functional Performance

10.1 State government should work to ensure that recognized standards for functional performance (end result delivery of service to the public) are met. Specifically, EMS communi-

cations systems should conform at least to minimum performance standards for public safety communications system contained in “Report on Police” (Ref (7)) and “Report on the Criminal Justice System” (Ref (8)), which have been broadly accepted by state and local public safety services and APCO as the basis for public safety communications systems planning and design. To the extent possible in view of local needs, resources, and capabilities; the standards should be applied uniformly throughout the state so that residents in rural areas do not necessarily receive lower levels of service than do urban residents.

10.2 *Objective*—EMSS requirement should be explicitly considered in plans for improvement of citizen-access communications.

10.2.1 Citizen-access communication systems (such as 9-1-1) handle all types of emergencies and are thus inherently broader in scope than EMSS. State EMSS authorities generally do not have the lead role in the development of citizen-access systems. The statewide development of 9-1-1 in many states, for example, has been assigned to the state emergency management or law enforcement authorities. State EMSS authorities should however participate in the statewide planning for expanding the coverage and enhancing existing 9-1-1 systems to ensure that EMSS requirements are taken into account. Guidelines for planning and developing 9-1-1 enhanced telephone systems are contained in Guide F 1381. Additional information regarding Emergency Medical Dispatch (EMD) is contained in Practice F 1258, Guide F 1552, and Practice F 1560. Following is a summary of the requirements for 9-1-1 enhanced telephone systems as set forth in Guide F 1381:

10.2.1.1 In any given area there should be only one telephone number to call for requesting emergency assistance. It is a national goal that this number should be “9-1-1.” A variety of supplemental and alternative arrangements exist in various areas of the United States and new alternative provisions for citizens access are being introduced and evaluated in areas where 9-1-1 implementation is not operationally or economically feasible. These alternatives include roadway telephone call boxes, cellular radio emergency telephone numbers, and area code 800 toll free emergency numbers. Such alternatives should include a single telephone number other than 9-1-1 for all types of emergencies or barring that, at least a single telephone number or other means of access for reporting the existence of all medical emergencies. The single telephone number or means of access should be published on the inside cover of telephone directories, displayed in public telephone booths and otherwise prominently displayed to the public. Citizens should not have to look up EMSS ambulance companies in the telephone directories to request emergency medical assistance. They should not have to know their location in relation to jurisdictional boundaries to determine the proper number to call. Whatever means are provided, citizen public telephone access to emergency services should incorporate the following features:

10.2.1.2 There should be no financial barrier to requesting emergency medical assistance. Coins should not be required for EMS calls from public phones. (This “dial tone first” feature is usually provided in 9-1-1 systems.) Long distance

EMS calls should be toll-free.

10.2.1.3 Sufficient lines should be provided to ensure that no more than one call for emergency medical assistance in 100 attempts receive a busy signal during the average busy hour (P.01 grade of service).

10.2.1.4 Sufficient answering positions and operators should be provided to ensure that at least 90 % of the calls for emergency medical assistance are answered within 10 s during the average busy hour.

10.2.1.5 Call answerers should be provided with written protocols for distinguishing calls for emergency medical assistance from other types of emergencies and should have adequate training to utilize the protocols effectively.

10.2.1.6 Call transfer or information relay, if used, should be fast and reliable. Call referral (telling the caller to hang up and call a different number) should never be used for calls for emergency medical assistance.

10.2.1.7 If call transfer is used, the caller should never have to talk to more than two people (for example, the 9-1-1 call answerer and the EMSS dispatcher).

10.2.1.8 Where feasible and appropriate, the development of alternative and backup systems for citizen access to emergency medical care should be encouraged. Such systems might include the use of citizen band radio and monitoring networks, cellular telephone, and radio call boxes. Also, police stations, fire stations, and government buildings equipped with two-way public safety radio service should be posted and made available for walk-in access to emergency medical care.

10.2.1.9 There should be a plan of action to maintain public access to emergency medical care when the primary telephone service of the 9-1-1 system becomes inoperative. The plan might include provisions for stationing radio equipped personnel at central locations such as malls, major intersections, schools, etc. The plan should include provisions for public safety announcements and alerts on local radio and television advising the public of the situation and what should be done to report emergencies.

10.3 *Objective*—EMSS resources should be coordinated:

10.3.1 EMSS communications in a local area should be organized so as to guarantee for each caller, that the nearest or most appropriate EMSS response unit(s) will be assigned to the call. This objective may be met by the use of “staging or move-up” plans to handle periods of peak EMS demand; by dynamic positioning of ambulances to enhance area-wide response readiness; by use of resource allocation protocols to assure that the most appropriate response unit is used; and by the development of an EMSS dispatch center usually in conjunction with a combined public safety dispatch center. The following requirements apply to an effective EMSS dispatch center:

10.3.1.1 The EMSS dispatch center should at all times monitor and be aware of the current location, status, and capability of all EMS response units in the area including private and public aeromedical units, ground ambulances, fire department EMS units, first responders, etc.

10.3.1.2 The EMSS dispatch center should be authorized and able to optimize the allocation of resources by preassigning specific units to particular locations in anticipation of need and

relocating units as conditions change.

10.3.1.3 The EMSS dispatch center should have written policies and procedures for the assignment of specific combinations of units to particular types of EMS incidents.

10.3.2 Computer aided dispatching which includes provisions for dispatching EMSS and other public safety services can facilitate coordination of emergency medical responses.

10.4 *Objective*—EMSS dispatch should be as direct as possible:

10.4.1 In the ideal case, the person who answers the call for emergency medical assistance is the radio dispatcher who can make direct contact with the units to be assigned to the incident. More commonly, however, one or more call transfers or information relays are necessary before the emergency information gets out to the response units who can actually act upon it. In any case, the chain of communications should be as short, simple, and direct as possible. The EMS caller should never have to talk to more than two people, for example, the 9-1-1 call answerer and the EMS dispatcher. Where the EMSS dispatcher must communicate with multiple units and locations for a given incident, the communications to all should occur simultaneously (or as nearly so as possible) using common or similar means of communications. There should also be some arrangement for positive feedback or an acknowledgment from each unit that the dispatch message has been received and understood.

10.4.2 EMSS dispatch should be prompt. The delay between the time of first notification of a medical emergency and the receipt of the dispatch message by the responding EMSS unit (ambulance or first responder) should never exceed 2 min. Using the standard practice described in Practice F 1258, 2 min is sufficient for an emergency medical dispatcher, trained in accordance with Guide F 1552, to interrogate a caller to determine the nature, severity, and most appropriate resource to dispatch.

10.5 *Objective*—EMSS communications systems should support statewide EMSS program requirements and local EMSS standard operating procedures by providing the following land mobile radio communications capabilities:

10.5.1 Provisions should exist for dispatch and coordination communications as described in 7.3. Statewide EMSS program requirements and local standard operating procedures should provide for prompt, reliable interagency coordination and direct access to communications for EMSS ambulance dispatch and coordination as described in 10.3 and 10.4.

10.5.2 Provisions for medical coordination/direction communications are described in 7.4. These provisions should conform with statewide EMSS program requirements and communication guidelines and should be incorporated in local EMSS communication plans so as to support local protocols for on-line medical direction to prehospital EMS response personnel.

10.5.2.1 A local (regional) EMSS communications plan should be prepared in accordance with state guidelines and should be kept updated. The plan should define the purposes and scope of the system and communication system features selected to support normal EMSS medical coordination procedures.

10.5.2.2 In areas where EMS ambulances frequently encounter medical emergencies in which patients are remote from ambulance access, consideration should be given to providing for two-way radio voice communications from EMS ambulance personnel at the immediate site of a medical emergency to an EMSS hospital. This communication capability permits on-line medical direction preparatory to moving a patient from a remote site to an EMS ambulance.

10.5.2.3 Provisions should exist for two-way voice communications between EMS ambulances and designated EMSS hospitals for consultation on patient status, treatment, and transport destination.

10.5.2.4 Provisions should exist for two-way voice communications between EMS ambulances and non-EMSS hospitals destined to receive EMS patients, for consultation regarding patient arrivals, patient condition, and need for transfer to EMSS hospitals.

10.5.2.5 The decision to require that an EMSS have provisions for biomedical telemetry from EMS ambulances and from the immediate site of medical emergencies, is an “off-line” EMSS medical control decision. If a decision is made to provide for biomedical telemetry, it should be incorporated into the system design.

10.5.2.6 Delay in EMSS hospital access to the channel being used for medical direction should be minimized. This can be accomplished by prescribing communications procedures restricting the duration of ambulance to hospital transmissions or by including design features to permit hospital preemption of the ambulance to hospital communications channel. The decision to provide communications system design features to permit EMSS hospitals to preempt a channel in use by an EMS ambulance (doctor interrupt) should be a matter for “off-line” medical control.

10.5.2.7 Provisions should exist for EMSS hospitals to arrange for direct two-way voice communications, as the need arises, with any other hospital within the EMSS area of responsibility that is destined to receive patients by EMSS ambulance. This may be accomplished by a variety of means such as direct radio link, if such exist, by radio-telephone interconnect, or by telephone.

10.6 *Objective*—EMSS communications systems should meet recognized standards while conforming to statewide EMSS program requirements and local EMSS communications plans. Some of these statewide requirements are listed below:

10.6.1 Statewide and local EMSS communications plans should contain provisions for reliable communications between EMSS ambulances for dispatch and routing from designated EMSS dispatch centers, and for medical direction from designated EMSS hospitals over the entire territory defined by statewide EMSS program requirements.

10.6.1.1 Each EMSS hospital should be able to communicate with any EMS ambulance within its area of responsibility, or to ambulances at any location which the hospital is the nearest or most appropriate emergency medical facility for issuing medical direction, or for exchange of patient pre-arrival information, or both.

10.6.1.2 Each EMS ambulance should be able to communicate with any radio-equipped EMSS hospital in the state,

when within range for mobile radio communications.

10.6.1.3 Each EMSS ambulance should be able to communicate by radio with any EMSS dispatch facility in the state when within range for mobile radio communications.

10.6.2 State and local (regional) EMSS communications plans should provide for statewide compatibility and interoperability of communications by defining statewide radio frequency requirements and compatibility factors for EMSS dispatch centers and for EMSS hospitals.

10.6.3 EMSS communications plans should specify a sufficient number of dispatch and medical coordination frequencies to reliably support the peak demand for EMSS communications with the same reliability as other public safety services.

10.6.3.1 For instances of peak EMS demand such as multiple casualty accidents, each EMSS hospital should be provided with sufficient radio frequencies and base stations to reliably support a simultaneous EMS communications demand equal to its capacity for simultaneous treatment of life threatening and serious medical emergencies for the duration of prehospital emergency medical care and transport to an EMSS hospital.

10.6.3.2 EMSS base stations should be equipped to avoid interference from reception of radio communications intended for other radio stations.

10.6.3.3 Consideration should be given to providing for selective calling of EMSS hospitals by EMSS ambulances.

10.6.4 In developing the statewide EMSS communication plan, consideration should be given to FCC licensing provisions, the number of frequencies available, their transmission characteristics, other authorized users of the various radio frequencies available for EMSS, and the impact of these features on the range of communication, and their adequacy for providing reliable communication for EMSS communication demands. Implementation of the FCC Rules on EMRS should result in a gradual reduction in the probability of interference and blockage of EMSS communications on these exclusive EMS radio frequencies. However, there may be increased probability of interference and blockage of EMSS communication by other authorized users on frequencies that are shared with non-EMS communications services.

10.7 *Objective*—The EMSS communications system design should ensure continued communications during disasters:

10.7.1 EMSS communications are particularly important during disasters. In order to ensure that an EMS communications system can satisfy the special needs for emergency medical response during a disaster, and not itself become disabled by the disaster, the system design should include the following considerations:

10.7.1.1 The public switched telephone network is susceptible to traffic overload and physical disruption during disasters. Leased private lines are protected from traffic overload but not physical outage. The system design should therefore provide alternative and backup communication links, such as radio and microwave. Telephone lines coming into communication centers should be protected from damage, and, where possible, alternate routing from multiple telephone company central offices should be used.

10.7.1.2 Means should be provided to allow police, fire,

rescue, and ambulance units from different agencies to communicate with each other directly during disaster operations. Available techniques include use of common disaster channels, multiagency multichannel radios, or cross-patch of channels at public safety communications base stations.

10.7.1.3 Fixed communications facilities should be provided with independent standby power sources to avoid dependency on commercial power.

10.7.1.4 Important locations in an area should be covered by more than one radio site so that communication is not totally lost in the event of failure of one radio site.

10.7.1.5 Sufficient telephone lines, radio channel capacity, and operating positions (or rapid expansion capability) should be designed into the system to handle heavy traffic loads generated by disasters.

10.7.1.6 Disaster communications procedures should be well defined with emphasis on interagency coordination. Disaster procedures should be straight forward expansions of day-to-day procedures rather than radical changes.

10.7.1.7 Disaster systems and procedures should be periodically exercised.

10.8 *Objective*—Communication operators should be trained in both emergency medical services and in communications:

10.8.1 Problems can be caused by physicians, nurses, and EMTs inexperienced in the use of communications equipment and also by public safety communications center personnel not familiar with EMSS concepts and terminology. Sufficient cross-training should therefore be provided on both sides to ensure that EMSS protocols and technical communications procedures are clearly understood and uniformly applied throughout the system. Physicians, nurses, and EMTs should be cross-trained in EMD communications practices and procedures as described in Practice F 1258 on the EMD practice, and Guide F 1552 on EMS training.

10.9 *Objective*—EMSS communications systems should meet technical standards applicable to all public safety communications systems:

10.9.1 The system must meet all applicable FCC rules and regulations.

10.9.2 All EMS communications should be recorded. The recording should include date and time signals. As a minimum, communication recordings should be retained at least as long as other local public safety communication recordings and beyond that for the period determined appropriate by applicable state EMS communications guidelines.

10.9.3 The reliability of radio coverage for two-way voice communications between an EMSS hospital and an EMS ambulance should be 0.95 or 95 %. This means that the medial signal level to and from an EMSS ambulance should exceed that necessary to provide 20 dB of quieting in the presence of ambient noise in 95 % of the randomly selected locations within the service area. Proof-of-performance tests should be made with the EMSS ambulance in motion.

10.9.4 The equipment must be durable and easy to operate. This is particularly true for equipment to be used by EMTs, physicians, and nurses.

11. Goal 2—Local EMSS Communications Should be Compatible with, and Should not Interfere with, EMSS Communications in Neighboring Areas

11.1 *Objective*—EMSS communications coverage boundaries should be defined and respected:

11.1.1 Normal radio communication coverage boundaries between neighboring EMSS should be mapped out and mutually agreed upon. Measures should be taken to respect the boundaries and minimize interference outside the boundaries by prudent base station transmitter site designs, including use of directional antennas, limiting antenna elevations and radiated power and other technical design features.

11.1.1.1 Interference can also be avoided by adoption of appropriate standard operating procedures, for example, for VHF communications, adopt “listen-before-talk” channel monitoring policies.

11.1.1.2 In UHF communications, centralized monitoring of all MED channel traffic and real-time centralized assignment of operating frequencies is one strategy for limiting interference with other EMSS communications as well as with non-EMSS users of the same spectrum. Digitally Addressed Trunked Communications Systems (DATCS) technology defined in APCO Project 16A, includes provisions for minimizing such interference. This technological approach to minimizing interference was recommended in Ref (3).

11.2 *Objective*—Frequency allocations and usage should be coordinated statewide and nationally when appropriate. State EMSS radio frequency usage plans are subject to changing provisions of the FCC Rules and Regulations. The State Office of Emergency Medical Services should assist with frequency coordination to establish a statewide frequency sharing pattern. The following advisory sections describe some of the implications of current FCC Rules and Regulations on statewide planning for coordinating the usage of radio frequencies available for communications so as to satisfy state EMSS program goals and objectives.

11.2.1 EMS dispatching is done on both VHF and UHF frequencies, and on frequencies in the 800 MHz band. In some areas, where EMS is provided by local government or fire services, local government or fire service frequencies are being used for EMS dispatching. In EMS systems where dispatching is to be performed on frequencies in different bands or radio services, state EMS authorities should employ frequency coordination services in planning and selecting frequencies and in planning base station radio coverage for EMS radio dispatching systems.

11.2.2 The UHF frequencies of MED-1 through MED-10 are subject to statewide use and must be coordinated by a state frequency coordinator. The state EMS communications plan is used as the framework for coordination of these frequencies and all mobile and portable radio equipment on these frequencies must incorporate all of the MED-1 through MED-10 channels. The state EMS communications plan should require that a minimum of four channels be operational within each station, unless a specifically identified need is demonstrated to and approved by the Office of Emergency Medical Services.

11.2.3 In some regions, such as large cities with populations greater than 4 000 000, it may be desirable to implement all

eight MED channels to prevent unsatisfactory communications because of overloading during the average daily busy hour. Real time frequency coordination, where channels are assigned on an “as needed real time basis” in these instances should be used to reduce interference. The communications design should be coordinated within the region. In the largest cities, even this communication capacity is insufficient to prevent unsatisfactory communication blockage because of overloading during the average daily busy hour. In such instances consideration should be given to various alternatives for reducing communication blockage such as changing communication protocols to reduce channel loading; employing communication technology to facilitate real-time communication channel sharing (digitally addressed trunking technology) or; based on FCC Rules on FCC Docket No. 87-112, planning for the use of additional spectrum in the 821-824/866-869 MHz bands. Whatever means is used, both dispatching and medical coordination communication for EMSS should have a grade of service such that blockage occurs no more than five times in a hundred attempts to access a channel (grade of service P.05).

11.2.4 In smaller cities and in rural areas, frequency coordination services can be used to establish area-wide frequency sharing pattern to provide a suitable grade of service for EMSS. Spare communication capacity should be provided for multi-casualty incidents and for disaster situations. Frequency coordination services must be used and may be helpful in assisting small communities to develop EMS communication plans that include provision for coordinated sharing of base station usage among EMSS users.

11.2.5 In smaller cities and in rural areas, frequency coordination services can be used to establish area-wide frequency sharing pattern to provide a suitable grade of service for EMSS. Spare communication capacity should be provided for multi-casualty incidents and for disaster situations. Communication capacity can be used to advantage for medical administrative communication and to permit rural physicians to stay in contact with their hospitals while they are on the road and otherwise away from their offices. Frequency coordination services must be used and may be helpful in assisting small communities to develop EMS communication plans which include provision for coordinated sharing of base station usage among EMSS users and other non-EMSS eligible medical use of the MED channels.

11.3 *Objective*—The provisions for continuous tone coded squelch system (CTCSS) tones and other control tones and codes should be coordinated statewide, including along interstate boundaries. This coordination function is not provided by FCC designated frequency coordinators and should be done by state EMS authorities. All agencies should advise the state EMS authority of the tones used. Records and data base should be established and maintained.

11.4 *Objective*—Regional and local systems should be interconnected with fixed radio links:

11.4.1 At least one frequency should be designated within a state as the standard frequency for inter-hospital communications for coordinating resources or response. This frequency should be implemented in all emergency hospitals and should extend to EMS dispatch and communications control centers to

permit hospital resources to be effectively coordinated with other public safety resources. Operating procedures should be established on a uniform basis regionally and statewide. The VHF frequencies 155.400 and 155.340 MHz have been used in many states for this purpose.

11.5 *Objective*—Mobile unit parameters should be standardized statewide for inter-system compatibility (interoperability):

11.5.1 The objective of interoperability is to enable every EMS mobile unit to travel anywhere in the state (for example, on a mutual aid assignment, or on a patient transport to a distant specialty care facility, or for disaster response) and to remain in communications with an EMSS at all times. Achievement of this objective would require the following:

11.5.1.1 All EMSS in a state should adhere to a common mobile frequency plan. The plan should provide for a statewide set of common calling frequencies by which an EMS ambulance operating out of its home region, can call EMSS hospitals for selection of a locally available radio frequency for medical coordination communications.

11.5.1.2 EMSS ambulances should be equipped for and informed of selective calling codes, and related equipment, and selective calling procedures to enable them to communicate with EMSS hospitals statewide.

11.5.1.3 EMSS ambulances should be equipped with and informed of tone-coded squelch, equipment, and procedures to enable them to communicate with EMSS hospitals statewide.

11.5.1.4 Equipment and procedures should be provided for maintenance of radio contact with an EMSS ambulance traveling from one EMSS region to another.

11.5.1.5 There should be statewide uniform training of communications operators. In order for the EMS communications system to function, the people, including the field teams, dispatchers, hospital personnel, and the system users, must know how to operate the telephone and radio equipment required for their communications. For example, the system users who use public telephones to call for emergency assistance must know what number to call. The field teams, dispatchers, telecommunicators and hospital and medical personnel must know how to operate their radio equipment and the procedures to use to establish and maintain radio contact. Although this may sound elementary, if the people who must operate the EMS communications equipment do not understand how the equipment or the system functions, they will not use it. This leads to misunderstandings, confusion and frustration at a minimum and could result in interference or a more serious consequence, including loss of life at ALS levels. Provisions for such training should be explicitly included in ASTM standards for training of EMS personnel. See Practice F 1031*, Practice F 1149, Guide F 1229, Guide F 1287*, Guide F 1418, and F 1453*.

NOTE 1—ASTM standard numbers marked with an “*” do not include explicit provisions for communications training. Liaison should be conducted between Subcommittees F30.02 on Training and F30.04 on Communications to recommend changes to these standards. New standards being developed for the paramedic and the ambulance operator should be reviewed to ensure that appropriate communications training is included.