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# Standard Guide for Emergency Medical Services System (EMSS) Telecommunications[1]

This standard is issued under the fixed designation F1220; 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:



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:*[2]

F1031 Practice for Training the Emergency Medical Technician (Basic)

F1149 Practice for Qualifications, Responsibilities, and Authority of Individuals and Institutions Providing Medical Direction of Emergency Medical Services

F1221 Guide for Interagency Information Exchange

F1229 Guide for Qualification and Training of EMS Air Medical Patient Care Providers

F1254 Practice for Performance of Prehospital Manual Defibrillation (Withdrawn 2007)[3]

F1258 Practice for Emergency Medical Dispatch

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

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

F1287 Guide for Scope of Performance of First Responders Who Provide Emergency Medical Care
F1381 Guide for Planning and Developing 9-1-1 Enhanced Telephone Systems (Withdrawn 2008)[3]
F1418 Guide for Training the Emergency Medical Technician (Basic) in Roles and Responsibilities (Withdrawn 2007)[3]
F1453 Guide for Training and Evaluation of First Responders Who Provide Emergency Medical Care
F1517 Guide for Scope of Performance of Emergency Medical Services Ambulance Operators
F1552 Practice for Training Instructor Qualification and Certification Eligibility of Emergency Medical Dispatchers
F1560 Practice for Emergency Medical Dispatch Management

2.2 *Federal Standards:*
Communications Act of 1934 (47 U.S.C. 405) (as amended)[4]
Title 47, United States Code of Federal Regulations (47 CFR) on Telecommunications[4]

## 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 EMSS 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 in which 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 EMSS 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**),[5] defines the following EMSS functions that 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 EMSS 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, and so forth) 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

[4] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

[5] The boldface numbers in parentheses refer to the references at the end of this guide.

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 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 EMS operations.

6.2.1 *EMSS Access*—Exchanges of information related to public access for reporting emergency medical situations to appropriate EMSS 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 use 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 "Nationwide 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 Executive 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 in which 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 dispatch the most appropriate EMS vehicles to the site of the emergency promptly,

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 before the patient's arrival and to provide for coordination between medical facilities. In areas in which 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 F1149.

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 communications 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."[6]

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 35 UHF band frequency pairs. Many of these frequencies are restricted for specific uses, such as paging, intersystem 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

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

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 that 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 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 to 48 MHz), the VHF "high band" (150 to 173 MHz), the UHF band (453 to 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 postinstallation 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.

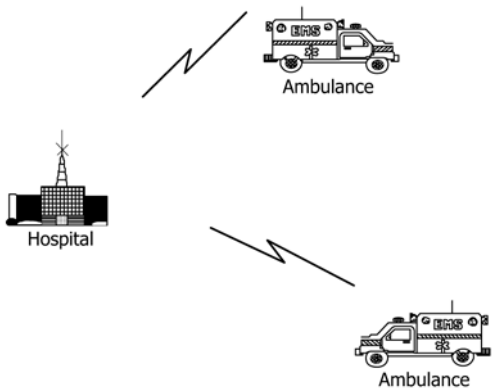
8.3 *Operational Considerations:*

8.3.1 Statewide communications planning, including interstate, 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 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




NOTE 1—*FCC Definitions (47 C.F.R. Sec. 90.7):*

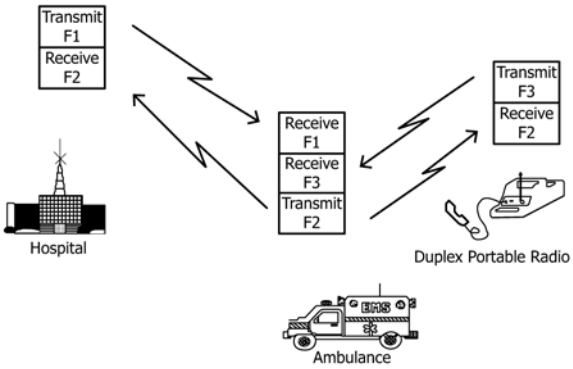
*mobile station*—a station in the mobile service intended to be used while in motion or during halts at unspecified points. This includes hand carried transmitters.

*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.

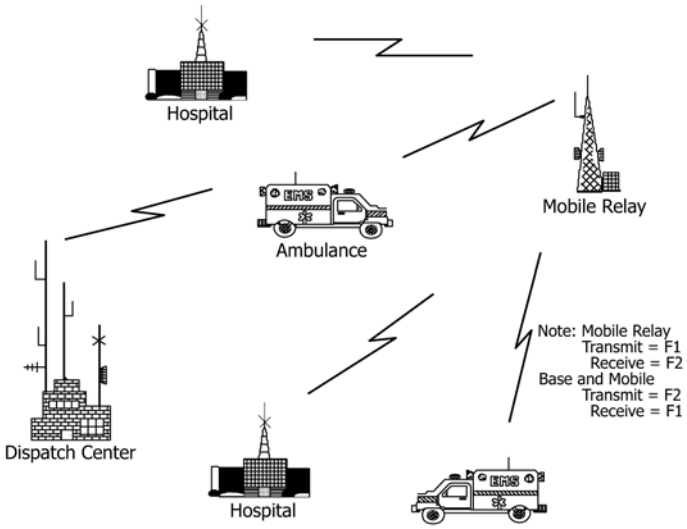
*hand carried transmitters*—See definition of *mobile station* under Fig. 1.

*mobile service*–See definition under 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**




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**

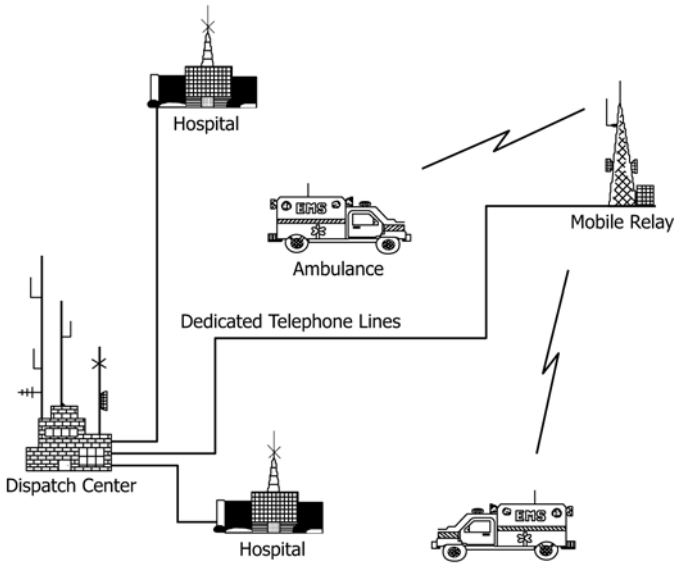
adjacent states. In general, state governments do not own or operate EMSS communications systems and do not exercise control over local systems. Instead, state governments act more in the role of planners, coordinators, regulators, and facilitators.

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.

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.




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**

9.6 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. Note 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 communications 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 F1381. Additional information regarding Emergency Medical Dispatch (EMD) is contained in Practice F1258, Practice F1552, and Practice F1560. Following is a summary of the requirements for 9-1-1 enhanced telephone systems as set forth in Guide F1381:

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 in which 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 use 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, and so forth. 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, and so forth.

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 F1258, 2 min is sufficient for an emergency medical dispatcher, trained in accordance with Practice F1552, 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 support reliably 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. 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 F1258 on the EMD practice, and Practice F1552 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 in which dispatching is to be performed on frequencies in different bands or radio services, state EMS authorities should use 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; using 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- to 824-/866-to 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 multicasualty 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 multicasualty 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 that 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-esignated frequency coordinators and should be done by state EMS authorities. All agencies should advise the state EMS authority of the tones used. Records and database 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 interhospital 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 intersystem 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. 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 F1031*, Practice F1149, Guide F1229, Guide F1287*, Guide F1418, and F1453*.

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.

## 12. Goal 3—Local EMSS Communications Should Be Compatible With, and Should Not Interfere With, Other Types of Communications Systems

12.1 EMSS communications should be coordinated with the law enforcement, fire, emergency management services and other public safety radio systems in their areas in terms of frequency usage, site engineering, and intersystem communications.

12.2 *Objective*—EMSS frequencies should be coordinated with other public safety frequencies.

12.2.1 Radio systems have the potential for mutually interfering with collocated and nearby systems in the other public safety services, even if the systems operate on other frequencies. For this reason EMS frequency assignments, site selection, elevation, and radiated power should be coordinated and examined each time systems are modified or expanded. Such problems can usually be resolved by local communications technicians. State EMS offices should provide technical communications assistance to resolve such problems that may arise if needed technical assistance is not available locally.

12.3 *Objective*—EMSS should be "good neighbors" at shared radio sites:

12.3.1 EMS radio equipment cannot be arbitrarily installed at a site without consideration of the effect on systems already using the site. Factors to be considered include the following:

12.3.1.1 Intermodulation analysis should be performed to predict likely levels of interference.

12.3.1.2 All of the radio equipment, including EMSS, should use isolators and bandpass cavity filters.

12.3.1.3 The minimum number of antennae should be used with adequate spacing to avoid interference.

12.3.1.4 Directional antennae should be used where appropriate.

12.3.1.5 Minimum radiated power should be used.

12.4 *Objective*—EMS radio systems should be compatible with other public safety systems for multiagency operations:

12.4.1 Compatibility can be achieved in the following ways:

12.4.1.1 EMSS and other public safety radios can be equipped with one or more special common mutual operating frequencies.

12.4.1.2 EMSS radios can be equipped with some of the working frequencies of the other public safety agencies and vice versa.

12.4.1.3 Cross-channel radio patch equipment can be used to establish a temporary functional interconnection of multiple agency channels.

12.4.1.4 Verbal relay of messages by a dispatcher is possible if the dispatch communications center has base stations or control equipment, or both, on all of the multiple agency frequencies.

## 13. Goal 4—EMSS Communications Should Make Maximum Use of State and Common Resources Where Appropriate, Cost Effective, and Authorized

13.1 Cost savings can be achieved by sharing such resources as radio sites, microwave and telephone systems, and system services such as centralized purchasing and training. This type of sharing also promotes interchange of ideas, standardization of equipment and procedures, and effective system interfaces.

13.2 *Objective*—EMSS communication planners should be encouraged to share radio sites:

13.2.1 In many states, the advantageous mountain top radio sites have already been developed. Some of these sites are operated by state agencies such as the Department of Transportation, state police, and state educational organizations. Some sites developed for specific EMSS communications may also be usable by neighboring EMSS. The state should encourage sharing of sites by the following practices:

13.2.1.1 Identifying advantageous sites that could be shared.

13.2.1.2 Cataloging site characteristics such as location, elevation, frequencies in use, shelter, rack and tower space available, and availability of commercial and standby power and telephone service.

13.2.1.3 Developing uniform policies for cost allocation, maintenance, interference avoidance by means of appropriate use of cavities, filters, and so forth.

13.3 *Objective*—EMSS communication planners should be encouraged to share state and common system components such as microwave and telephone:

13.3.1 There are many extensive state-operated microwave systems for statewide interconnection of communication control centers and mountain-top radio sites and for support of state-owned government telephone services. These and similar resources could be advantageously used in EMSS communications for such purposes as control of remote base stations and repeaters, a backup alternative to commercial telephone facilities, and replacement of expensive leased telephone lines.

To encourage sharing of these resources, states should inventory them, make their characteristics and capabilities known to EMSS planners, and develop policies for shared use.

13.4 *Objective*—EMSS communication planners should be encouraged to make effective use of state-provided services.

13.4.1 State government should act on behalf of local EMSS to take advantage of economies of scale and efficiencies not otherwise available to the local systems. Examples of opportunities in this area include the following:

13.4.1.1 Provide centralized purchasing through state contracts. This can be particularly advantageous for the purchase of EMSS radio equipment using federal grants, and it probably could be extended to cover "pooled" purchases with private funds.

13.4.1.2 Develop arrangements for statewide maintenance services.

13.4.1.3 Offer engineering design services to local EMSS communications planners.

13.4.1.4 Develop and provide standardized equipment specifications and request for proposal and contract boilerplate materials.

13.4.1.5 Offer or sponsor EMSS communications operator training programs.

## 14. Goal 5—The State Should Act as the Representative of Local EMSS in Dealing with Federal Agencies and National Organizations

14.1 In most states, a state EMSS director, in the state department of health acts as a fiscal agent in application and distribution of grants for EMSS from a number of federal programs. There is a need for broadening the scope of activity to encompass functions that affect EMSS statewide, may be beyond the capability of small local EMSS, and are legitimate functions for state government. Following are some examples of such functions:

14.1.1 Monitoring activity at the federal and national level including federal and private foundation grant programs, laws, and rule changes affecting EMSS communications.

14.1.2 Seeking out and securing new sources of funding.

14.1.3 Participating in the regulatory decision-making process at the federal level, particularly by commenting on FCC dockets that may impact on EMSS communications.

14.2 *Objective*—The state government should monitor federal and national level activity affecting EMSS communications:

14.2.1 The state should have a systematic mechanism for maintaining awareness of EMSS activity at the federal and national level, assessing the effects of that activity on EMSS communications, and communicating the findings to local EMSS planners. Activities of interest include:

14.2.1.1 Announcements of new federal or private foundation grant programs, changes in existing programs, and grant awards.

14.2.1.2 Significant new advances in EMSS communications technology or system management.

14.2.1.3 New or changed laws affecting EMSS.

14.2.1.4 Changes in FCC Rules and Regulations and in federal agency EMSS grant criteria.

14.3 *Objective*—The state should assist local EMSS planners in identifying and securing outside sources of funds:

14.3.1 State EMSS directors play a critical role in this area by administering grant funds for EMSS from various federal programs. The federal grant programs are generally limited to "seed funding" and at best are limited and unreliable as long range funding sources. Local funding sources are also severely limited. The need remains for specific improvements in EMSS communications. States should become active in locating and using new sources of funding such as private foundation grant programs. In some states, statutes have been enacted to raise funds for EMSS by requiring a mandatory additional financial penalty for each traffic violation. Other states have imposed a surcharge for EMSS for each renewal of a passenger motor vehicle registration.

14.4 *Objective*—The state should take an active role to influence federal communication law and rule-making decisions.

14.4.1 Local EMSS communications planners have little power and few opportunities to affect or influence the development of federal laws and regulations that have impact on them. The state government has the power to affect events at the national level and has many opportunities to do so. What is needed is an organized program to channel states efforts in this area. Such a program might include the following:

14.4.1.1 Review and comment, where appropriate, on FCC notices of inquiry and rule-making proposals affecting EMSS communications.

14.4.1.2 Review and comment on proposed regulatory changes in other federal agencies, such as NHTSA, DHHS, and FEMA.

14.4.1.3 Use of state lobbyists in matters affecting EMSS communications.

14.4.1.4 Informing state-elected representatives of the significance of issues affecting EMSS communications.

## 15. Goal 6—The State Should Have a Program for Positive Management of Its EMSS Communications Activities

15.1 State EMSS directors should have an EMSS communication management program to identify and resolve interstate as well as intrastate communication coordination problems.

15.2 *Objective*—EMSS communication planning should be established as an ongoing process. In developing a state plan, the planner should be cognizant of the requirements of the FCC rules and address differences between the rules and the plan. For example, the state plan may require more frequencies for specific uses above and beyond the requirements of the federal rules.

15.2.1 Current detailed guidance and information for statewide EMSS communications planning is contained in (**4**).

15.2.2 Statewide EMSS communications planning is needed to resolve issues arising from shortages of spectrum and other uncertainties. For example, in some situations, the FCC rules permit EMSS to use 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, Business Radio

Service, and others. Such use, however, must meet eligibility requirements or be covered by cooperative use agreements with an existing licensee. These requirements should be considered in the planning process. Even with the creation of the Emergency Medical Radio Service, there are still insufficient radio frequencies available to meet the demands of all eligible users. Additionally, there are no specific provisions within the FCC Rules and Regulations for EMS aeromedical or helicopter communications. These unique communications, including flight following and wide range radio coverage must be addressed in future FCC rules and communications guidelines.

15.2.3 The completion of a statewide EMSS communication master plan and regional planning guidelines should be a primary planning objective. As a next step, the state should encourage and support development of subsidiary regional level plans. After that, all of the plans at all levels should be reviewed at frequent intervals (at least every two years) and adjusted to adapt to changing conditions. While these plans are important, the planning process, and continuing contacts among state and local EMSS communication planners are paramount. Only through such an ongoing planning process is it possible to get consensus on the many communication system features that must be standardized statewide if EMSS functional performance objectives are to be achieved.

15.3 *Objective*—Statewide aeromedical communications radio frequency plans should be developed and implemented to enable emergency aeromedical services to communicate with all necessary elements of other emergency medical and public safety services. These plans should include:

15.3.1 Radio frequencies for air/ground vehicle communications to ensure that any aeromedical rotor-wing aircraft can communicate with any ground EMS vehicle.

15.3.2 Radio frequencies for air/hospital communications to ensure that any aeromedical rotor-wing aircraft can communicate with hospital emergency departments.

15.3.3 Provisions for an aeromedical communications center to ensure that any aeromedical rotor-wing aircraft can communicate with their communications center.

15.3.4 As a precondition for such planning, state EMS authorities should support for authorization of such frequencies from the Federal Communications Commission, The Federal Aviation Administration, and certified frequency coordinators.

15.4 There is a need for some type of statewide organizational structure to carry out planning, implementation, and management of regional and local EMSS communications. This structure should be made responsive to current needs by shifting the focus of its work from the pursuit of specific grant funding objectives to the more substantive concerns of system functional performance such as interregional cooperation, noninterference, utilization of shared and common resources, and overall system management. In addition, the organization must be provided with state-level technical staff support.

15.5 *Objective*—States should strengthen their own EMSS communications personnel resources and assist with local and regional personnel standards and training.

15.5.1 The agency of state government having overall responsibility for EMSS should be concerned and involved in technical communication matters. There should be a communication specialist on the state EMSS staff. This person should assume responsibility for much of the total state involvement outlined in its EMSS communication master plan including observance of functional performance standards, arbitration of intersystem interference problems, development of compatibility standards, promotion of sharing of state and common resources, interface with federal and national organizations, and overall communication program management.

15.5.2 In addition, the state should help regional and local systems in certain personnel areas. For example, the state should establish qualifications and standards for EMSS communication operators along the lines of existing EMT standards. The state should also provide or sponsor communication training programs for communication center operators (professional telecommunicators), hospital communication equipment operators (doctors and nurses), and mobile communication equipment operators (EMTs).

15.5.3 The State EMS authority should participate in the frequency coordination process required under Section 90.27 of FCC Rules to assist eligible nongovernmental applicants to obtain licenses from the FCC to operate on the EMRS frequencies. This requires coordination with the International Municipal Signal Association (IMSA) and the International Association of Fire Chiefs (IAFC), which are the Federal Communication Commission recognized frequency coordinators for the Emergency Medical Radio Service and the Special Emergency Radio Service.

15.5.3.1 For radio license applications by entities in the EMRS, FCC Rules Section 90.27 requires that an application be accompanied by a statement prepared by the governmental body having jurisdiction over the state's emergency medical service plans indicating that the applicant is included in the state's emergency plan or otherwise supporting the application. The essential components of this statement attest that: the applicant provides basic or advanced life support services on a ongoing basis, the application is in conformance with (or not in conflict with) the state's EMC communications plan, and the statement is supported by an authorized signature.

15.5.3.2 The state office of emergency medical service should establish a method by which the statement (letter or authorization) is provided. This authorization procedure should be documented and filed with the IMSA/IAFC frequency coordinator. There should be a method established to determine the applicant's eligibility under the FCC's Rules. The state EMS Director, or his designee, is normally the signatory for establishing this eligibility. The designated person must be knowledgeable of the technical aspects of the EMS communications systems within the state.

15.6 *Objective*—The state should provide positive direction by means of laws, rules, and funding policies.

15.6.1 Generally, state laws and regulations regarding communications are nonexistent or weak because of preeminence of FCC Rules and Regulations relative to communications. Ways should be sought by states to regulate communications in matters affecting the safety of life, as with EMSS communications. One obvious need is regional and local adherence to the statewide EMS communication master plan, when

approved, should be mandatory. There should be legal minimum qualifications and requirements for EMSS communication operators since these people are just as important to patient safety and well-being as EMTs, and the state should ensure that they are well-qualified. State-level management responsibilities and organizational structures for EMSS communications should be clearly defined in state law.

15.7 *Objective*—Mechanisms should be developed to provide for feedback of information on EMSS communications, evaluation of the information, and corrective action.

15.7.1 These mechanisms could include methods such as the use of periodic questionnaires, meetings, and problem referrals. They could also extend to more direct and forceful methods such as an inspection program. In general, the state should assist local communications managers in early identification of problems and prompt and effective solutions.

## 16. Keywords

16.1 emergency medical services; telecommunications

## APPENDIXES

**(Nonmandatory Information)**

### X1. EMERGENCY MEDICAL RADIO SERVICE (EMRS) FREQUENCIES (MHz)

### X1.1 VHF High Band

X1.1.1 *Base or Mobile:*

155.325 ... Biomedical telemetry allowed in some areas.[7]
155.340 ... Biomedical telemetry allowed in some areas.

X1.1.1.1 May be designated by common consent as an intersystem mutual assistance frequency under an area-wide medical communications plan.

155.355 ... Biomedical telemetry allowed in some areas.[7]
155.385 ... Biomedical telemetry allowed in some areas.[7]
155.400 ... Biomedical telemetry allowed in some areas.[7]

X1.1.2 *Mobile-only:*

150.775
150.790

X1.1.3 *Base/Mobile:*

220.9025/221.9025[8]
220.9075/221.9075[8]
220.9125/221.9125[8]
220.9175/221.9175[8]
200.9225/221.9225[8]
220.8025/221.8025.Public Safety/Mutual Aid (except PS)[8]
220.8075/221.8075.Public Safety/Mutual Aid (except PS)[8]
220.8125/221.8125.Public Safety/Mutual Aid (except PS)[8]
220.8175/221.8175.Public Safety/Mutual Aid (except PS)[8]
220.8225/221.8225.Public Safety/Mutual Aid (except PS)[8]
220.8275/221.8275.Public Safety/Mutual Aid (except PS)[8]
220.8325/221.8325.Public Safety/Mutual Aid (except PS)[8]
220.8375/221.8375.Public Safety/Mutual Aid (except PS)[8]
220.8425/221.8425.Public Safety/Mutual Aid (except PS)[8]
220.8475/221.8475.Public Safety/Mutual Aid (except PS)[8]

### X1.2 *UHF Band:*

X1.2.1 *Base/Mobile:*

453.025/458.025 . . Biomedical telemetry permitted.[9,10]
453.075/458.075 . . Biomedical telemetry permitted.[9,10]
453.125/458.125 . . Biomedical telemetry permitted.[9,10]
453.175/458.175 . . Biomedical telemetry permitted.[9,10]
460.525/465.525 . . Shared with Police and Fire services[11]
460.550/465.550 . . Shared with Police and Fire services[11]
462.950/467.950 . . MED 9—Vehicle Coordination[12,13]
462.975/467.975 . . MED 10—Vehicle Coordination[12,13]
463.000/468.000 . . MED 1—Medical Coordination[14]
463.025/468.025 . . MED 2—Medical Coordination[13]
463.050/468.050 . . MED 3—Medical Coordination[14]
463.075/468.075 . . MED 4—Medical Coordination[14]
463.100/468.100 . . MED 5—Medical Coordination[15]
463.125/468.125 . . MED 6—Medical Coordination[15]
463.150/468.150 . . MED 7—Medical Coordination[15]
463.175/468.175 . . MED 8—Medical Coordination[15]

[7] Licensees may transmit one-way alert paging to ambulance and rescue squad personnel on a secondary basis on these frequencies.

[8] See FCC Rules 47 CFR, Subpart T for "Regulations Governing Licensing and Use of Frequencies in the 220-222 MHz Band".

[9] Paging licenses as of March 20, 1991 may continue to operate on a primary basis until January 14, 1998.

[10] Highway radio call box operations first licensed before March 31, 1980 permitted in accordance with FCC Rules §90.17(c) **(11)**.

[11] Intra- and inter-system mutual assistance allowed.

[12] Licensees may transmit one-way alert paging to ambulance and rescue squad personnel on a secondary basis on these frequencies.

[13] This frequency is primarily authorized for use in the dispatch of medical care vehicles and personnel for the rendition of medical services. This frequency may also be assigned for intra- and inter-system mutual assistance. The frequency pairs 462.950/467.950 and 462.975/467.975 may be referred to as MED-9 and MED-10, respectively.

[14] This frequency is authorized for use for operations in biomedical telemetry stations. Entities eligible in this Radio Service may use this frequency on a secondary basis for any other permissible communications consistent with FCC Rules 90.27(a).

[15] This frequency is authorized for communications between medical facilities and personnel related to medical supervision and instruction for the treatment and transport of patients in the rendition or delivery of medical services. Entities eligible in this Radio Service may use this frequency on a secondary basis for any other permissible communications consistent with FCC Rules 90.27(a).

X1.2.2 *Shared With All Other Public Safety Radio Services:*

| | | |
|---|---|---|
| 453.050/458.050 | 453.400/458.400 | 453.750/458.750 |
| 453.100/458.100 | 453.450/458.450 | 453.800/458.800 |
| 453.150/458.150 | 453.500/458.500 | 453.850/458.850 |
| 453.200/458.200 | 453.550/458.550 | 453.900/458.900 |
| 453.250/458.250 | 453.600/458.600 | 453.950/458.950 |
| 453.300/458.300 | 453.650/458.650 | |
| 453.350/458.350 | 453.700/458.700 | |

**X1.3** *90.53 Frequencies Available:*

X1.3.1 Table X1.1 indicates frequencies available for assignment to stations in the Special Emergency Radio Service, together with the class of station(s) to which they are normally assigned and the specific assignment limitations that are explained in X1.3.2. (Frequencies below 450 MHz indicated for base or mobile stations may be authorized to fixed stations on a secondary basis to stations in the mobile service):

**TABLE X1.1 Special Emergency Radio Service Frequency Table**

| Frequency or Band | Class of Station(s) | Limitations |
|---|---|---|
| Kilohertz: | | |
| 2000 to 3000 | Fixed | 1 |
| 2726 | Base or mobile | 2 |
| 3201 | do | ... |
| Megahertz: | | |
| 33.02 | do | 3, 25 |
| 33.04 | do | 25 |
| 33.06 | do | 3, 25 |
| 33.08 | do | 25 |
| 33.10 | do | 3, 25 |
| 35.02 | Mobile | 27 |
| 35.64 | Base | 4 |
| 35.68 | do | 4 |
| 37.90 | Base or mobile | 3, 25 |
| 37.94 | do | 3, 25 |
| 37.98 | do | 3, 25 |
| 43.64 | Base | 4, 28 |
| 43.68 | do | 4 |
| 45.92 | Base or mobile | 25 |
| 45.96 | do | 25 |
| 46.00 | do | 25 |
| 46.04 | do | 25 |
| 47.42 | do | 5, 25 |
| 47.46 | do | 25 |
| 47.50 | do | 25 |
| 47.54 | do | 25 |
| 47.58 | do | 25 |
| 47.62 | do | 25 |
| 47.66 | do | 25 |
| 72.00 to 76.00 | Operational-fixed | 6 |
| 150 to 170 | Base or mobile | 30 |
| Megahertz: | | |
| 152.0075 | Base | 4, 31 |
| 155.160 | Base or mobile | 25 |
| 155.175 | do | 25 |
| 155.205 | do | 25 |
| 155.220 | do | 25 |
| 155.235 | do | 25 |
| 155.265 | do | 25 |
| 155.280 | do | 25 |
| 155.295 | do | 25 |
| 157.450 | Base | 4, 11 |
| 163.250 | do | 4 |
| 169–172 | Mobile | 33 |
| 450–470 | Fixed | 12 |
| 453.025 | Base | 26 |
| 453.075 | do | 26 |
| 453.125 | do | 26 |
| 453.175 | do | 26 |
| Megahertz: | | |
| 806 to 824 | Mobile | 21 |
| 851 to 869 | Base or mobile | 21 |
| 928 and above | Operational-fixed | 22 |
| 929 to 930 | Base only | 7 |
| 1427 to 1435 | Operational-fixed, base or mobile | 23 |
| 2450 to 2500 | Base or mobile | 24 |
| 10 550 to 10 680 | do | 9 |

X1.3.2 Explanation of assignment limitations appearing in Table X1.1:

(*1*) Appropriate frequencies in the band 2000 to 3000 kHz which are designated in Part 80 of this chapter as available to Public Ship Stations for telephone communications with Public Coast Stations may be assigned on a secondary basis to Special Emergency fixed stations for communication with Public Coast Stations only, provided such stations are located in the United States and the following conditions are met:

(*i*) That such fixed station is established pursuant to the eligibility provisions of §90.47 and that the isolated area involved in an island or other location not more than 480 km (300 statute miles) removed from the desired point of communication and isolated from that point by water.

(*ii*) That evidence is submitted showing that an arrangement has been made with the coast station licensee for the handling of emergency communications permitted by §80.453 and §90.47(d) of this chapter.

(*iii*) That operation of the special emergency fixed station shall at no time conflict with any provision of Part 80 of this chapter and further, that such operation in general shall conform to the practices employed by Public Ship Stations for radiotelephone communication with the same Public Coast Station.

(*2*) This frequency is shared with the Local Government Radio Service where it is available for state guard operations.

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

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

(*5*) This frequency is reserved for assignment only to national organizations eligible for disaster relief operation under§ 90.41.

(*6*) The frequencies available for use at operational fixed stations in the band 72 to 76 MHz are listed in §90.257(a) (1). These frequencies are shared with other services and are available only in accordance with the provisions of §90.257.

(*7*) Frequencies in this band are available only for one-way paging operations in accordance with §90.494 of this part.

(*8*) (Reserved).

(*9*) The frequencies in the band 10.55 to 10.68 GHz are available for digital termination systems and for associated internodal links in the Point-to-Point Microwave Radio Service. No new licenses will be issued under this subpart but current licenses will be renewed.

(*10*) (Reserved).

(*11*) Operations on this frequency are limited to 30-W transmitter output power.

(*12*) The requirements for secondary fixed use of frequencies in this band are set forth in §90.261.

(*13*) (Reserved).

(*14*) (Reserved).

(*15*) (Reserved).
(*16*) (Reserved).
(*17*) (Reserved).
(*18*) (Reserved).
(*19*) (Reserved).
(*20*) (Reserved).
(*21*) Subpart S contains rules for assignment of frequencies in the 806- to 824-MHz and 851- to 869-MHz bands.
(*22*) Assignment of frequencies above 928 MHz for operational-fixed stations is governed by Part 94 of this chapter.
(*23*) This frequency band is available in this service subject to the provisions of §90.259.
(*24*) Available only on a shared basis with stations in other services, and subject to no protection from interference as a result of the operation of industrial, scientific, or medical (ISM) devices. In the 2483.5- to 2500-MHz band, no applications for new or modification to existing stations to increase the number of transmitters will be accepted. Existing licensees as of July 25, 1985, or on a subsequent date following as a result of submitting an application for license on or before July 25, 1985, are grandfathered and their operation is coprimary with the Radio Determination Satellite Service.
(*25*) A licensee regularly conducting two-way communication operations on this frequency may, on a secondary basis, also transmit one-way alert-paging signals to ambulance and rescue squad personnel.
(*26*) Paging licensees as of March 20, 1991 may continue to operate on a primary basis until January 14, 1998.
(*27*) This frequency is available in this service only to persons eligible under the provisions of §90.38(a) for operation of transmitters having a maximum power output of 3 W using F1031A1A, F1031A1D, F1149A2B, F1149A2D, F1B, F1D, F2B, F2D, G1B, G1D, G2B, or G2D emission. This frequency is also available in the Business Radio Service on a coequal basis with the Special Emergency Radio Service users.
(*28*) No new licenses will be granted for one-way paging under§ 90.487 for use on this frequency after August 1, 1980. This frequency is available to persons eligible for station licenses under the provisions of §90.38(a) on a coequal basis with one-way paging users under §90.487 before August 1, 1985 and on a primary basis after August 1, 1985. Only A1A, A1D, A2B, A2D, F1B, F1D, F2B, F2D, G1B, G1D, G2B, G2D emissions and power not exceeding 10 W will be authorized. Antennas having gain greater than 0 dBd will not be authorized. Transmissions shall not exceed a 2-s duration.
(*29*) (Reserved).
(*30*) Rules concerning the use of this band for narrowband operations are set forth in §90.271.
(*31*) This frequency is removed by 22.5 kHz from frequencies assigned to other radio services. Utilization of this frequency may result in, as well as be subject to, interference under certain operating conditions. In considering the use of this frequency, adjacent channel operations should be taken into consideration. If interference occurs, the licensee may be required to take the necessary steps to resolve the problem. See §90.173(b).
(*32*) (Reserved).
(*33*) Frequencies in this band will be assigned for low power wireless microphones in accordance with the provisions of§ 90.265.
(*34*) (Reserved).

(*c*) Additional frequencies available. In addition to the frequencies shown in the frequency table of this section, the following frequencies are available in this service. (See also §90.253.)

(*1*) Substitution of frequencies available below 25 MHz may be made in accordance with the provisions of§ 90.263.
(*2*) (Reserved).
(*3*) Frequencies in the band 73.0 to 74.6 MHz may be assigned to stations authorizing their use on or before December 1, 1961, but no new stations will be authorized in this band, nor will expansion of existing systems be permitted. (See also §90.257.)
(*4*) The frequency bands 31.99 to 32.00 MHz, 33.00 to 33.01 MHz, 33.99 to 34.00 MHz, 37.93 to 38.00 MHz, 39.00 to 39.01 MHz, 39.99 to 40.00 MHz, and 42.00 to 42.01 MHz are available for assignment for developmental operation subject to the provisions of Subpart Q.
(*5*) Frequencies in the 421- to 430-MHz band are available in the Detroit, Cleveland, and Buffalo areas in accordance with the rules in §§90.273 through 90.281.

(*d*) Limitation on number of frequencies assignable. Normally only one frequency below 450 MHz will be assigned for mobile service operations by a single applicant in a given area. The assignment of an additional frequency will be made only upon a satisfactory showing of need, except that:

(*1*) Additional frequencies above 25 MHz may be assigned in connection with the operation of mobile repeaters in accordance with §90.247, notwithstanding this limitation.
(*2*) An additional frequency may be assigned for paging operations from those frequencies available under §90.53(b)(4).
(*3*) The frequency 155.340 MHz may be assigned as an additional frequency when it is designated as a mutual assistance frequency as provided in §90.53(b)(10).
(*4*) Additional frequencies may be assigned for fixed station operations.
(*5*) Frequencies in the 25 to 50 MHz, 150 to 170 MHz, and 450 to 512 MHz bands, and the frequency bands 903 to 904 MHz, 904 to 912 MHz, 918 to 926 MHz, and 926 to 927 MHz may be assigned for the operation of automatic vehicle monitoring (AVM) systems in accordance with §90.239, notwithstanding this limitation.

## X2. ACRONYMS AND GLOSSARY FOR EMS COMMUNICATIONS

### X2.1 Acronyms

**A**

**AAT**—above average terrain.
**AC**—alternating current.
**ACD**—automatic call distributor.
**ACLS**—advanced cardiac life support.
**ACSB**—amplitude compandored single-sideband.
**ADP**—automatic data processing.
**AGL**—above ground level.
**ALS**—advanced life support.
**ALERT**—automatic law enforcement response team.
**ALI**—automatic location identification.
**AM**—amplitude modulation.
**AMSL**—above mean sea level.
**ANI**—automatic number identification.
**APB**—all points bulletin.
**APCO** —Associated Public-Safety Communications Officers.
**ASCII**—American standard code for information interchange.
**ASTM** —American Society for Testing and Materials.
**ASTRA**—Automated Statewide Telecommunications and Records Access.
**ATLS**—Advanced Trauma Life Support.
**AT&T**—American Telephone and Telegraph Company.
**AVC**—automatic volume control.
**AVI**—automatic vehicle identification.

**B**

**balun**—balanced-to-unbalanced line transformer.
**BCD** —binary coded decimal.
**BFO**—beat frequency oscillator.
**BIT**—binary digit.
**BLS**—basic life support.
**BPS**—bits per second.
**BSC**—binary synchronous communications.

**C**

**C**—Celsius.
**CAD**—computer-aided dispatch.
**CB**—citizens band.
**CCH**—computerized criminal history.
**CCITT**—International Telegraph and Telephone Consultative Committee.
**CCSA**—common control switching arrangement.
**CCTV**—closed circuit television.
**CCU**—Coronary Care Unit or Critical Care Unit.
**CDC**—Cooperative Dispatch Center.
**CG** —Channel Guard (R) Trademark of General Electric.
**CMED**—Central Medical Emergency Dispatch.
**CMR**—Common Mode Rejection.
**CMRR** —Common Mode Rejection Ratio.
**CNIL**—Calling Number Identification and Location.
**CO**—Central Office.
**COG**—Council of Governments.
**COR**—Coronary Observation Radio.
**CPR**—cardiopulmonary resuscitation.
**CJIS**—Criminal Justice Information System.
**CTCSS**—continuous tone controlled squelch system.

**D**

**dB**—decibel.
**dBm**—decibel referenced to 1 mW.
**dBu**—decibel referenced to 1 μV/m.
**dBv**—decibel referenced to 1 V.
**dBW**—decibel referenced to 1 W.
**DC**—direct current.
**DCS**—Division of Computer Services.
**DDD**—direct distance dialing.
**DID** —direct inward dialing.
**dod**—direct outward dialing.
**DOD** —U.S. Department of Defense.
**DOT**—U.S. Department of Transportation.
**DRG**—diagnosis related grouping.
**DP**—double pole.
**DPDT**—double pole double throw.
**DTMF**—dual-tone multifrequency.
**DPST**—double pole single throw.

**E**

**EACOM**—emergency and administrative communications system.
**EAS**—extended area service.
**E & M**—the receive and transmit leads of a signaling system.
**EAX**—electronic automatic exchange.
**ECC**—emergency communications center.
**ECG**—electrocardiogram.
**EDP**—electronic data processing.
**EIA** —Electronic Industries Association.
**EMD** —emergency medical dispatcher.
**EMF**—electromotive force.
**EKG**—electrocardiogram.
**EMDPRS**—emergency medical dispatch priority reference system.
**EMS**—emergency medical service.
**EMSS**—emergency medical service system.
**EMT**—emergency medical technician.
**EMT-B**—emergency medical technician-basic.
**EMT-AI**—emergency medical technician-advanced intermediate.
**EMT-D**—emergency medical technician-defibrillator.
**EMT-I**—emergency medical technician-intermediate.
**EMT-IV**—emergency medical technician-intraveneous certified.
**EMT-P**—emergency medical technician-paramedic.
**EOC**—emergency operations center.
**EOM**—end of message.
**ERCC**—emergency resource coordination center.
**ERP**—effective radiated power.
**ESS**—electronic switching system.
**EST**—Eastern Standard Time.
**ETA**—Estimated Time of Arrival.
**ETV** —Educational Television.

**F**

**F**—Fahrenheit.
**FCC**—U.S. Federal Communications Commission.

**FCCA**—Forestry Conservation Communications Association.
**FEMA**—Federal Emergency Management Agency.
**FET**—field-effect transistor.
**FM**—frequency modulation.
**freq.**—frequency.
**FORTRAN**—formula translation (computer language).
**FSK**—frequency-shift keying.
**FX** —foreign exchange.

**G**

**GE**—General Electric.
**GESS**—General Electric Service Station.
**GFW**—ground fault warning.
**GHz**—gigahertz (1000 MHz).
**GIGO**—garbage in, garbage out.
**GMT** —Greenwich mean time (Zulu).
**GSA**—General Services Administration.
**GT&E**—General Telephone and Electronics.

**H**

**HEAR**—hospital emergency administrative radio.
**HF**—high frequency.
**HYSIS**—highway safety information system.
**HV**—high voltage.
**Hz**—hertz.

**I**

**I**—current in amperes.
**IAFC**—International Association of Fire Chiefs.
**IACP**—International Association of Chiefs of Police.
**IC**—integrated circuit.
**ICO**—individual channel oscillator.
**ICOM**—integrated circuit oscillator module.
**ICU**—intensive care unit.
**ICX**—intercity exchange link.
**IEEE**—Institute of Electrical and Electronic Engineers.
**IF**—intermediate frequency.
**IMSA**—International Municipal Signal Association.
**IMTS**—improved mobile telephone service.
**IRAC**—interdepartmental radio advisory committee.
**ISPERN**—Illinois State Police Emergency Radio Network.
**IT&T**—International Telephone and Telegraph Corporation.
**ITU**—International Telecommunication Union.

**J**

**JAN**—Joint Army-Navy Specifications.
**JETEC**—joint electron tube engineering council.
**JFET**—junction field-effect transistor.
**JEMS**—Journal of Emergency Medical Services.

**K**

**kbps**—kilobits per second.
**kHz**—kilohertz (1000 hertz).

**L**

**LATA**—local access transport area.
**LMR**—land mobile radio.
**LEAA**—law enforcement assistance administration.
**LETS** —Law Enforcement Teletypewriter Service.
**LORAN**—long-range navigation.
**LSI**—large-scale integration.
**LOS**—line of sight.
**LRO**—lead regional organization.
**LSU**—life support unit.

**M**

**MAST** —Military Assistance to Safety and Traffic.
**MCCU**—mobile coronary care unit.
**MF**—medium frequency.
**MHz**—megahertz.
**MICT**—Mobile Intensive Care Technician.
**MICU**—Mobile Intensive Care Unit.
**MRCC**—Medical Resource Coordination Center.

**N**

**NABER**—National Association of Business and Educational Radio, Inc.
**NCIC**—National Crime Information Center.
**NCMCN**—North Carolina Medical Communications Network.
**NEAR**—National Emergency Aid Radio.
**NHTSA**—National Highway Traffic Safety Administration.
**NLETS** —National Law Enforcement Telecommunications System.
**Nxx**—see definition in glossary section.
**NPA**—number plan area.

**O**

**O-D**—origin-destination.
**ONI**—operator number identification.
**OTP**—Office of Telecommunications Policy.

**P**

**PABX**—Private Automatic Branch Exchange.
**PBX**—Private Branch Exchange.
**PL** —Private Line (R) Trademark of Motorola.
**PM**—Pulse Modulation.
**PSAP**—public safety answering point.
**PSCC**—Public Safety Communications Council.
**PTT**—press to transmit or push to talk.

**Q**

**QEI**—quantifiable evaluation indicator.

**R**

**RCU**—remote control unit.
**RF**—radio frequency.
**Rx**—receive.

**S**

**SERS**—Special Emergency Radio Service.
**SIRSA**—Special Industrial Radio Service Association, Inc.
**SMR**—Specialized Mobile Radio.
**SMSA**—standard metropolitan statistical area.
**SPA**—State Planning Agency.
**SWR** —Standing Wave Radio.

**T**

**TASI**—time assignment speech interpolation.
**TCAM**—telecommunications access method.
**Telco** —telephone company.
**TELPAK**—see definition in glossary section.
**TPL**—terminal per line.
**TPS**—terminal per station.
**TSPS**—see definition in Glossary section.
**Tx**—transmit.

**U**

**UHF**—ultra-high frequency.
**UL**—Underwriters Laboratories, Inc.
**UPS**—uninterruptible power supply.

**USITA**—U.S. Independent Telephone Association.
**USFS**—U.S. Forest Service.

**V**

**V**—volts.
**VAC**—volts, alternating current.
**VDC**—volts, direct current.
**VHF**—very high frequency.
**VOM**—volt-ohm meter.
**VOR**—voice operated relay.
**VOX**—voice operated switch.
**VSWR**—voltage standing wave ratio.
**VTVM**—vacuum tube voltmeter.
**VU**—Volume Unit.

**W**

**WATS**—Wide Area Telephone Service.
**WECO**—Western Electric Company.
**WPM**—words per minute.

**X**

**Xcvr.**—transceiver.
**Xfmr.**—transformer.
**Xmit.**—transmit.
**Xmtr.**—transmitter.
**Xtal**—crystal.

**Z**

**Z**—impedance.
**ZULU**—time zone at Greenwich, England.

### X2.2 FCC Codes and Names of Radio Services

*Industrial:*

*IB*—business
*IF*—forest products
*IM*—motion picture
*IP*—petroleum
*IS*—special industrial
*IT*—telephone maintenance
*IW*—power
*IX*—manufacturers
*IY*—relay press

*Motor Carrier:*

*LI*—interurban passenger
*LJ*—interurban property
*LU*—urban passenger
*LV*—urban property

*Land Transportation:*

*LA*—automobile emergency
*LR*—railroad
*LX*—taxicab

Public Safety:

*PF* —fire
*PH* —highway maintenance
*PL* —local government
*PP* —police
*PO* —forestry conservation
*PS*—special emergency
*RS*—radiolocation
*ZA*—general mobile

*Classes of Radio Stations (FCC):*

*FB*—base
*FB2* —mobile relay
*FB4*—community repeater
*FX1*—control
*MO*—mobile
*MO3*—mobile/vehicular repeater
*FXO*—operational fixed
*FX2*—fixed relay
*FX*—fixed
*FLT*—auxiliary test
*FXY*—interzone
*FXZ*—zone
*LR*—radio location
*MR*—radio location mobile

*806- to 821-/851- to 866-MHz Bands:*

| Conventional | Category | Trunked |
|---|---|---|
| GB | business | YB |
| GO | industrial/land transportation | YO |
| GP | public safety/special emergency | YP |
| GX | commercial (SMRS) | YX |

*929 to 930-MHz Band:*

GS—private carrier paging systems

### X2.3 Glossary

X2.3.1

**A**

X2.3.1.1 **acoustic feedback**—the transfer of sound waves from a loud speaker or end terminal to any previous component within an audio system, such as a microphone. Acoustic feedback may be audible, subaudible, or superaudible.

X2.3.1.2 **activity**—the expenditure of time and resources.

X2.3.1.3 **adapter**—a device used for changing the terminal connections of a circuit or part to connect to another circuit or part with unlike connections.

X2.3.1.4 **alphabet, phonetic**—a method of passing alphabetic information over a poor communication path with word substitution for letters. One phonetic alphabet is: Alfa; Bravo; Charlie; Delta; Echo; Foxtrot; Golf; Hotel; India; Juliett; Kilo; Lima; Mike; November; Oscar; Papa; Quebec; Romeo; Sierra; Tango; Uniform; Victor; Whiskey; X-ray; Yankee; Zulu.

X2.3.1.5 **American Standard Code for Information Interchange (ASCII)**—an eight-level code for data transfer adopted by the American Standards Association to achieve compatibility between data devices.

X2.3.1.6 **amplitude compandored single-sideband**—a form of sideband modulation used for narrow channel transmission that incorporates a pilot tone.

X2.3.1.7 **amplitude modulation (AM)**—modulation in which the amplitude of the carrier-frequency current is varied above and below its normal value in accordance with the audio, picture, or other intelligence signal to be transmitted.

X2.3.1.8 **analog**—physical representation of information such that the representation bears an exact relationship to the original information. Pertaining to data in the form of continuously variable physical qualities.

X2.3.1.9 **analog communication**—system of telecommunications used to transmit information other than voice which is sometimes used in telemetry.

X2.3.1.10 **antenna**—a system of wires or electrical conductors used for reception or transmission of radio waves. Specifically, a radiator that couples the transmission line or lead-in to space for transmission or reception of electromagnetic radio waves. It changes electrical currents into electromagnetic radio waves and vice versa.

X2.3.1.11 **antenna, isotropic**—a theoretical antenna with identical radiation in every direction.

X2.3.1.12 **antenna, parabolic**—a directional antenna with a radiating (or receiving) element and a paraboloid reflector that concentrates the power into a beam.

X2.3.1.13 **antenna polarization**—the direction of the radiated electric field in relation to the surface of the earth. Generally vertical in mobile radio use.

X2.3.1.14 **arc**—a discharge of electricity.

X2.3.1.15 **arrester, lightning**—a device designed to protect electrical equipment or property from damage by lightning.

X2.3.1.16 **assigned frequency**—the frequency appearing on a station authorization from which the carrier frequency may deviate by an amount not to exceed that permitted by the frequency tolerance.

X2.3.1.17 **Associated Public-Safety Communications Officers (APCO)** —a nonprofit public safety radio users group composed of administrators and communications technical, operations, and command personnel.[16]

X2.3.1.18 **ASTM**—a scientific and technical organization formed for the development of standards on characteristics and performance of materials, products, systems, and services.[17]

X2.3.1.19 **attack time**—the interval required after a sudden increase in input signal to a transducer (transmitter, receiver, and so forth) to attain a percentage of final output level as a result of this increase.

X2.3.1.20 **attenuation**—the decrease in amplitude of a signal during its transmission from one point to another. It may be expressed as a ratio or, by extension of the term, in decibels.

X2.3.1.21 **attenuator**—a device for reducing the energy of a wave without introducing distortion. Also called a pad, gain control, level adjustor, volume control, and so forth.

X2.3.1.22 **audible signal**—a buzzer, bell, or other audible sound device that indicates an incoming call.

X2.3.1.23 **audio**—pertaining to frequencies corresponding to normally audible sound waves. These frequencies range from 15 to 20 000 Hz.

X2.3.1.24 **aural**—pertaining to the ear or sound.

X2.3.1.25 **automatic gain control (AGC)**—a receiver circuit that maintains the output constant with wide variations in the receiver input level.

X2.3.1.26 **automatic volume control (AVC)**—a self-acting gain control that maintains the output of a receiver constant despite variations in received signal strength.

X2.3.1.27 **automatic number identification (ANI)**—equipment for recording the calling party's number without operator intervention.

**B**

X2.3.1.28 **back bone**—a point-to-point communications system using several stations.

X2.3.1.29 **back-to-back repeater**—a repeater consisting of a receiver and transmitter with the output of the receiver connected directly to the input of the transmitter.

X2.3.1.30 **band (radio frequency)**—a range of frequencies between two definite limits. By international agreement, the radio spectrum is divided into nine bands. For example, the very high-frequency (VHF) band extends from 30 to 300 MHz.

X2.3.1.31 **bandpass filter**—passes frequencies within a specified band and attenuates all frequencies outside that band.

X2.3.1.32 **bandwidth**—(*1*) the width of a band of frequencies used for a particular purpose and (*2*) the range of frequencies within which a performance characteristic of a device is above specified limits. For filters, attenuators, and amplifiers these limits are generally taken to be 3 dB (half-power) below the average level.

X2.3.1.33 **baseband**—for microwave systems, the available frequency band that the RF equipment is capable of transmitting.

X2.3.1.34 **base station**—an item of fixed radio hardware consisting of a transmitter and a receiver.

X2.3.1.35 **baud**—used to define the operating speed of a printing telegraph or data system. It is the total number of discrete conditions or signal events per second.

X2.3.1.36 **baudot code**—a five-unit code used for teletypewriter signals.

X2.3.1.37 **beacon**—a radio transmitter or lights designed to indicate exact geographical location or direction.

X2.3.1.38 **beam**—a configuration of radiated energy whose rays are sharply directional and parallel.

X2.3.1.39 **beat**—a regularly recurring pulsation from the combination of two-tone or frequency waves of different frequencies.

X2.3.1.40 **beat frequency**—the frequency produced when signals of two different frequencies are combined and refracted. The beat frequency is equal in value to the difference between the original frequencies.

X2.3.1.41 **bel**—a unit of relative power, named after Alexander Graham Bell, and used to express differences in power.

X2.3.1.42 **beeper**—a pocket-paging receiver that emits a beeping sound upon receiving a page specifically directed to it.

X2.3.1.43 **biomedical telemetry (biotelemetry)**—the technique of monitoring or measuring vital biological parameters and transmitting data to a receiving point at a remote location.

X2.3.1.44 **Biophone**—trade name of Biocom, Inc. for portable telemetry devices.

[16] APCO Headquarters office, 351 N. Williamson Blvd., Daytona Beach, FL 32114–1112.

[17] ASTM Committee F30 is developing consensus standards for emergency medical services. ASTM International Headquarters, 100 Barr Harbor Dr., West Conshohocken, PA 19428.

X2.3.1.45 **bit**—a unit of digital information (abbreviation of "binary digit").

X2.3.1.46 **boom microphone**—a microphone arranged on an arm-type mechanical support to permit better placement of the microphone.

X2.3.1.47 **braid**—a group of fibrous or metal filaments or threads woven into a cylindrical shape to form a covering over one or more wires.

X2.3.1.48 **broadcast**—radio or television transmission intended for general reception.

X2.3.1.49 **Business Radio Service**—a subpart of the Industrial Radio Services section of the FCC rules.

X2.3.1.50 **busy indicator**—an indicator provided at a control point to indicate the in use condition of a circuit or channel.

**C**

X2.3.1.51 **cable**—one or more insulated or noninsulated wires used to conduct electrical current or impulses. Grouped insulated wires are called a multiconductor cable.

X2.3.1.52 **calibrate**—to determine error by comparison with a known standard.

X2.3.1.53 **call, all**—the alerting of all decoder-equipped units in a system by the transmission of a single coded signal.

X2.3.1.54 **call, group**—the alerting of subdivided selective call groups by function, type of vehicle, location, and so forth by sending a single coded signal.

X2.3.1.55 **call, individual** —the alerting of a specific coded decoder unit by sending a single coded signal.

X2.3.1.56 **call answerer**—the initial answerer of a call for assistance whether by 9-1-1 or other telephone method.

X2.3.1.57 **call sign**—Federal Communications Commission assigned identifying letters and numbers used for identification of a radio station, transmitter, or transmission.

X2.3.1.58 **call referral method**—the calling party is referred to a secondary number.

X2.3.1.59 **call relay method**—the call is answered at the PSAP where the pertinent information is gathered and then the interrogator relays the information to the proper public safety agency for their action. This can be accomplished by radio, intercom, telephone, and so forth.

X2.3.1.60 **call transfer method**—the PSAP interrogator determines the proper responding agency and connects the user to that agency which then performs the necessary dispatching in accordance with prearranged plans with cooperating agencies.

X2.3.1.61 **call party hold**—enables the public safety answering point to control the connection for confirmation and tracing of a call.

X2.3.1.62 **capture effect**—an effect occurring in FM reception when the stronger of two signals on the same frequency suppresses the weaker signal.

X2.3.1.63 **cardioid microphone**—a microphone having a heart-shaped space response pattern of 180° in front and minimum response in the rear.

X2.3.1.64 **carrier**—a radio signal generally without voice or other information.

X2.3.1.65 **carrier control timer (CCT)**—a device that limits the length of time that the transmitter carrier is on.

X2.3.1.66 **carrier frequency** —the frequency of an unmodulated electromagnetic wave produced by the transmitter.

X2.3.1.67 **cavity resonator**—a space enclosed by a metal conductor in which oscillating electromagnetic energy is stored and whose resonant frequency is determined by the geometry of the enclosure.

X2.3.1.68 **cellular radio**—a commercially available mobile or portable radio telephone service.

X2.3.1.69 **Celsius**—the metric scale of temperature in which water freezes at 0° and boils at 100°C. To convert a Celsius temperature to Fahrenheit, multiple by 9/5 and add 32.

X2.3.1.70 **central medical emergency dispatch (CMED)**—see **command and control center**.

X2.3.1.71 **central office**—sometimes called a wire center; the smallest subdivision within the telephone system which has relatively permanent geographic boundaries.

X2.3.1.72 **change out**—to replace.

X2.3.1.73 **channel element**—a temperature-compensated crystal oscillator.

X2.3.1.74 **channel guard**—General Electric's trademark for continuous tone-coded squelch system (CTCSS).

X2.3.1.75 **channel, point-to-point**—a radio channel used for radio communications between two definite fixed stations.

X2.3.1.76 **channel, radio**—an assigned band of radio frequencies of sufficient width to permit its use for radio communication. The necessary width of a channel depends on the type of transmission and the tolerance for the frequency of emission.

X2.3.1.77 **channel, television**—a band of radio frequencies 6 MHz wide used for television broadcast.

X2.3.1.78 **channelization**—the assignment of circuits to channels and the arrangement of those channels into groups.

X2.3.1.79 **charge**—to replenish the electrical potential in a battery or capacitor.

X2.3.1.80 **charge, fast or quick**—a method of quickly recharging batteries under controlled conditions.

X2.3.1.81 **charge, trickle**—the continuous charge of a battery at a slow rate.

X2.3.1.82 **chart, 4/3 earth's radius**—a radio profile chart whose horizontal lines are curved to correspond to an earth having a radius ⅘ times larger than actual earth radius.

X2.3.1.83 **chassis**—the framework on which parts of a radio or other electronic circuits are mounted.

X2.3.1.84 **circuit merit**—a rating of overall circuit quality. Circuit merit '5' is clear circuit. Merit '3' is readable with noise. Any rating below '3' is not readable and generally unacceptable.

X2.3.1.85 **class of service**—service order code designation of the combination of telephone service features (equipment,

calling area units, dial types) to which business and residence customers subscribe. It is used for rating, identification, and assignment purposes.

X2.3.1.86 **coaxial cable**—a transmission line in which one conductor completely surrounds the other, the two being coaxial and separated by a continuous solid dielectric or by dielectric spacers.

X2.3.1.87 **code dialing**—a method of signaling or encoding and decoding address codes by the use of standard telephone dial.

X2.3.1.88 **command and control center (central communications center)**—a system that is responsible for establishing communications channels and identifying the necessary equipment and facilities to permit immediate management and control of an EMS patient. This operation must provide access and availability to public safety resources essential to the effective and efficient EMS management of the immediate EMS problem.

X2.3.1.89 **common mode rejection (CMR)**—the ability of a differential amplifier to reject unwanted signals.

X2.3.1.90 **communications subsystem**—comprises those resources and arrangements for notifying the EMS system of an emergency, for mobilizing and dispatching resources, for exchanging information, for remote monitoring of vital indicators, and for the radio transmission of treatment procedures and directions.

X2.3.1.91 **communications system**—a collection of individual communication networks, transmission system, relay stations, control and base stations, capable of interconnection and interoperations that are designed to form an integral whole. The individual components must serve a common purpose, be technically compatible, use common procedures, respond to control, and operate in unison.

X2.3.1.92 **comparator**—a circuit that compares two or more signals and selects the strongest or best.

X2.3.1.93 **compression**—in audio systems, reducing the volume range of the input signal so that the minimum output has less noise and the maximum output has less distortion.

X2.3.1.94 **compressor**—a variable gain audio device used to provide a relatively constant output level for a wide range of varying input levels.

X2.3.1.95 **computer**—an electrical device that can accept information, process it mathematically in accordance with previous instructions, and provide the results of this processing.

X2.3.1.96 **cone of silence**—the area directly over or under a vertical transmitting antenna in which little or no signal is radiated.

X2.3.1.97 **console**—a cabinet housing electronic circuitry normally used in controlling other equipment such as transmitters and receivers installed at a remote location.

X2.3.1.98 **continuous tone-controlled squelch system (CTCSS)**—a system wherein radio receiver(s) are equipped with a tone responsive device which allows audio signals to appear at the receiver audio output only when a carrier modulated with a specific tone is received. The tone must be continuously present for continuous audio output. CTCSS functions are sometimes referred to by various trade names such as private line or PL (Motorola Communications & Electronics), Channel Guard or CG (General Electric Mobile Radio), or Quiet Channel (RCA).

X2.3.1.99 **control console**—a desk-mounted, enclosed piece of equipment which contains a number of controls or circuits used to operate a radio station.

X2.3.1.100 **control head**—a device with appropriate controls, microphone, volume, squelch, on/off, and so forth, generally mounted in a vehicle, from which control of the radio or mobile unit is performed.

X2.3.1.101 **control point**—a position from which a radio system is controlled and supervised.

X2.3.1.102 **control, remote**—a control scheme for a radio system in which all control functions are performed remotely via telephone lines.

X2.3.1.103 **consolette** —(*1*) Motorola Communications name for a desk top radio station and (*2*) a device for mounting a mobile microphone, control head and speaker.

X2.3.1.104 **continuous duty**—(*1*) an unending transmission, (*2*) operating 100 % of the time, (*3*) EIA—full-load output under the manufacturers normal loading conditions for the class of service for 24 h.

X2.3.1.105 **control, local**—a control system packaged with the control unit mounted directly on the base station.

X2.3.1.106 **coordination, frequency**—the cooperative selection and allocation of radio frequencies such that all systems can operate with minimum interference.

X2.3.1.107 **couple**—to connect two circuits so that signals are transferred from one to the other.

X2.3.1.108 **coverage**—in a radio communications system, the geographic area where reliable communications exist; usually expressed in terms of miles extending radially from a fixed radio station.

X2.3.1.109 **crosstalk**—the unwanted transfer of energy from one communication circuit to another by means of a mutual coupling.

X2.3.1.110 **crystal**—a piece of quartz or similar material that has been ground thin and to the proper size to produce vibrations at the desired frequency. Used in radio transmission to generate, with a high degree of accuracy, the assigned carrier frequency of a station.

X2.3.1.111 **cut over**—to transfer from one system to another.

X2.3.1.112 **cycle**—one complete reversal of an alternating current, including a rise to the maximum level in one direction and a return to zero. The number of cycles occurring in 1 s is the frequency of the current. The word cycle is commonly used to mean cycles per second (now called hertz).

**D**

X2.3.1.113 **dBm**—decibels referenced to 1 mW. Used in communication work as a measure of absolute power. Zero dBm equals 1 mW.

X2.3.1.114 **dBV**—decibels referenced to 1 V.

X2.3.1.115 **dBW**—decibels relative to 1 W (1 dBw = 30 dBm).

X2.3.1.116 **decibel (dB)**—a unit that expresses the level of power value relative to a reference power value. Specifically, the level of power, value *P*, relative to a reference value, *PR*, in decibels is defined as $dB = 10*\log_{10}(P/PR)$.

X2.3.1.117 **DC control**—a remote base station control scheme that requires metallic conductors and currents of different values to control the station's various functions.

X2.3.1.118 **decoding**—the conversion and recognition by the addressed (receiving) unit of numerical address codes that have been transmitted through a communications system.

X2.3.1.119 **dedicated telephone line**—a telephone wire pair, originating at one point, and terminating at another point, operating in a closed circuit. Also called a private line.

X2.3.1.120 **defibrillator** —an electrical device used to eliminate fibrillation of the heart muscle by the application of high voltage impulses.

X2.3.1.121 **demodulation**—the process of recovering the modulating information from a modulated signal.

X2.3.1.122 **deviation ratio**—the ratio of the maximum frequency deviation of the RF carrier to the highest frequency contained in the modulating band.

X2.3.1.123 **dial tone first**—allowance of a 9-1-1 or '0' operator calls to be completed without the deposit of a coin in a telephone pay station.

X2.3.1.124 **digital**—data represented in discrete, discontinuous form, as contrasted with analog data represented in continuous form.

X2.3.1.125 **digital dial code**—a signaling technique generally used in VHF radio systems to bypass a receiver CTCSS system.

X2.3.1.126 **diplexer**—a device that enables the use of two radio transmitters, operating on different frequencies, on the same antenna simultaneously.

X2.3.1.127 **direct**—in terms of communications circuits, means a dedicated, instant method of communications. A dial telephone is not direct, a radio or a ring down line are direct.

X2.3.1.128 **direct dispatch method**—a system in which all 9-1-1 call answering and radio dispatching is performed by the personnel at the public safety answering point.

X2.3.1.129 **direct distance dialing (DDD)**—telephone service that permits subscribers to dial their own long distance calls.

X2.3.1.130 **direct leased land lines**—dedicated or designated point-to-point wire circuits (telephone) used in transmitting voice or data communications. See: **dedicated telephone line**.

X2.3.1.131 **direct trunking**—an arrangement in which a telephone line connection has no intermediate points before reaching the final destination (called) party.

X2.3.1.132 **directional antenna**—an antenna that radiates radio waves more effectively in some directions than in others.

X2.3.1.133 **directivity**—the value of the direction gain of an antenna in the direction of its maximum value.

X2.3.1.134 **dish**—a type of antenna. A parabolic reflector used in microwave systems.

X2.3.1.135 **dispatch point**—a position from which a radio system is used but not a supervision or control point. Dispatch points are not usually listed on a station radio license.

X2.3.1.136 **distortion**—unfaithful reproduction of audio or video signals as a result of change occurring in the wave form of the original signal somewhere in the course of its transmission or reception. The lower the percentage of distortion, the more distortion free the system is and the more intelligible the message.

X2.3.1.137 **diversity** —a method of radio transmission, or reception, or both, that counteracts the effects of fading by combining several signals all bearing the same information.

X2.3.1.138 **doctor-interrupt**—the ability of a physician or hospital-based communicator to interrupt the voice or telemetry transmission from a radio in the field.

X2.3.1.139 **dual-tone-multifrequency (DTMF)**—the simultaneous generation of two audio tones generally compatible to AT&T's standard "Touch-Tone" frequencies. Used for control or signaling purposes. A method of sending numerical information from an encoder by sending specific pairs of audio tones for each digit, up to a total of 16.

X2.3.1.140 **duplex** —the operation of transmitting and receiving apparatus at one location in conjunction with associated transmitting and receiving apparatus at another location: the process of transmission and reception being simultaneous. The simultaneous transmission and reception of information. A duplexed piece of equipment is capable of transmitting and receiving simultaneously. Duplex systems generally use different transmitting and receiving frequencies.

X2.3.1.141 **duplexed operation**—the operation of associated transmitting and receiving apparatus concurrently as in ordinary telephones without manual switching between talking and listening periods. For comparison, see **simplex operation**.

X2.3.1.142 **duplexed/multiplexed telemetry unit**—a radio device capable of simultaneous transmission and reception and concurrent transmission of both voice and EKG information.

X2.3.1.143 **duplexer**—a device that is used in radio equipment to provide simultaneous transmit and receive capabilities on a single antenna.

X2.3.1.144 **duplex, half**—a system in which communication may be in either direction but only one way at a time. Transmission in one direction at a time over a single channel.

**E**

X2.3.1.145 **E & M signaling**—an arrangement by which signaling between two points on a radio or carrier path is accomplished. An *M* lead is associated with the transmit (or mouth) while the *E* lead is associated with the receiver (or ear).

X2.3.1.146 **EACOM**—Emergency and Administrative Communications for hospitals. Tradename for a VHF radio system operating on standard frequencies with a selective

calling system between stations. The system is similar to Motorola Communications HEAR radio system.

X2.3.1.147 **effective height**—the true electrical height of an antenna corresponding to a "perfect" antenna that will produce the same field strength. The height of its center of radiation above the effective ground level.

X2.3.1.148 **effective radiated power (ERP)**—the calculated power output from an antenna system which incorporates all the gains and losses in the antenna system. ERP is calculated as follows (*1*) convert power output of transmitter to dB referenced to 1 W (dBw); (*2*) subtract all transmission line losses including losses in equipment between the transmitter and antenna (filter, diplexers, circulators, duplexers, and so forth) expressed in dB; (*3*) add the antenna's power gain (expressed in dB reference to a half-wave dimple; and (*4*) convert the results into watts.

X2.3.1.149 **effective signal radiated**—the rating basis for licensing radio transmitters. Equal to the square root of the effective radiated power times the antenna height in feet above ground level.

X2.3.1.150 **EKG display console**—a unit of electronic equipment located in a hospital emergency room, or cardiac care unit, or both, which displays EKG and records voice and data information received from an EMS scene by transmission via radio or telephone path. A demodulation display console.

X2.3.1.151 **electrocardiogram (ECG or EKG)**—a visual or hard copy trace of a patient's electrical heartbeat information.

X2.3.1.152 **electrode**—(*1*) either of the two terminals of an electric source, such as a battery; (*2*) a conducting element through which electric current enters or leaves an electrolyte, gas, or vacuum; (*3*) a conducting element, usually metallic (such as silver/silver chloride), with a conducting medium or electrolyte (such as sodium chloride and water) attached to a patient to obtain the electrical signals of the heart.

X2.3.1.153 **electromagnetic radiation**—radiation associated with a periodical varying electric and magnetic field and is traveling at the speed of light, including radio waves, light waves, X-rays, and gamma radiation.

X2.3.1.154 **electromagnetic wave**—a wave of electromagnetic radiation, characterized by variations of electric and magnetic fields.

X2.3.1.155 **emergency call**—a call that requires immediate action.

X2.3.1.156 **emergency medical dispatcher (EMD)**—a trained public safety telecommunicator with additional training and specific emergency medical knowledge essential for the efficient management of emergency medical communications.

X2.3.1.157 **emergency medical dispatching**—the reception and management of requests for emergency medical assistance.

X2.3.1.158 **emergency medical dispatch priority reference system (EMDPRS)**—a medically approved reference system used by a local dispatch agency to dispatch aid to medical emergencies, which includes: systematized caller interrogation questions, systematized prearrival instructions, and protocols matching the dispatcher's evaluation of injury or illness severity with vehicle response mode and configuration.

X2.3.1.159 **Emergency Medical Service (EMS)**—the service used in responding to the perceived individual need for immediate medical care to prevent loss of life or aggravation of physiological or psychological illness or injury.

X2.3.1.160 **emergency operations center (EOC)**—(*1*) a secure, protected facility designed and equipped for the use of community officials to manage response of a community in time of emergency and (*2*) a communications center designed and operated by a community or within a geographic area for a combination of emergency resources, such as police, fire, and EMS.

X2.3.1.161 **emergency resource coordination center (ERCC)**—generally a facility that has the resources and ability to coordinate all emergency services (police, fire, EMS, and so forth) within a given geographic area. ERCC works in conjunction with a public safety answering point (PSAP) and may be in the same facility or location.

X2.3.1.162 **enclosure**—a housing such as a case, cabinet, cabinet rack, or console that is designed to provide protection and support to equipment.

X2.3.1.163 **encoding**—the conversion of numerical address codes, such as telephone number or message codes, into a format of tone or on-off pulses of audio tones for transmission over a communications system, usually for individual or group addressing, such as for paging or selective calling.

X2.3.1.164 **exchange**—a defined area, served by one or more telephone central offices, within which the telephone company furnishes service.

X2.3.1.165 **exciter**—the low-level stages of a transmitter which normally consist of an oscillator, modulator, and multiplier.

X2.3.1.166 **extender board**—a printed circuit board that plugs into a module's circuit connector at one end and the module on the other to maintain a circuit so that the module may be conveniently tested out of an inaccessible position.

**F**

X2.3.1.167 **facility**—a communications facility is anything used or available for use in the furnishing of communications service.

X2.3.1.168 **facsimile**—the process by which pictures, images, and other fixed graphic materials are scanned and the information converted into electrical signals for local use or transmission remotely to produce a likeness of the subject copy.

X2.3.1.169 **fading**—the variation of radio field strength caused by a gradual change in the transmission medium.

X2.3.1.170 **fade margin**—the number of decibels of attenuation that can be added to a specified radio frequency propagation path before the signal-to-noise ratio of the channel falls below a specified minimum.

X2.3.1.171 **FCC Part 90**—the section of the Federal Communications Commissions Rules and Regulations that affects most EMS communications.

X2.3.1.172 **Federal Communications Commission (FCC)**—a board of commissioners appointed by the President under the Communications Act of 1934 to formulate Rules and Regulations and to authorize use of radio communications. The FCC regulates all communications in the United States by radio or wireline, including television, telephone, radio, facsimile, and cable systems.

X2.3.1.173 **feedback**—the act of returning a portion of the output voltage of a circuit which includes amplification to the input of that circuit.

X2.3.1.174 **feedback, acoustic**—the feeding back of sound waves from a loudspeaker to a microphone in the same audio system.

X2.3.1.175 **field strength**—the strength of an electric, magnetic, or electromagnetic field. Electromagnetic (radio) field strength is expressed in microvolts per metre or millivolts per metre.

X2.3.1.176 **fixed service**—a service or radio communication between specified fixed points. Fixed station—(*1*) a radio station that is not mobile, (*2*) a station that is permanently installed, and (*3*) a base station in a mobile radio system.

X2.3.1.177 **fixed relay station**—an operational fixed station established from the automatic retransmission of radio communications received from either one or more fixed stations or from a combination of fixed and mobile stations and directed to a specified location.

X2.3.1.178 **F-Layers**—the upper layers of ionization in the ionosphere. The f-1 layer is about 130 miles above the earth. The f-2 layer height varies from about 250 miles during the day to about 150 miles at night.

X2.3.1.179 **float**—to operate a storage battery in parallel with a charger and a load at such voltage that the charger supplies the load current and the battery supplies only transient peaks above the normal load.

X2.3.1.180 **FM transmitter**—a radio transmitter that emits or radiates a frequency modulated wave.

X2.3.1.181 **folded dipole**—a receiving or transmitting antenna composed of two parallel dimples connected at the ends. The connection to the receiver or transmitter is made at the center of one of the poles.

X2.3.1.182 **forced disconnect**—the capability of the 9-1-1 center to disconnect a 9-1-1 call to avoid caller jamming of the incoming phone lines.

X2.3.1.183 **four wire operation**—telephone operation in which the inbound audio signal is carried on one pair of wires and the outbound signal on another pair.

X2.3.1.184 **free space loss**—the theoretical radiation loss that would occur in transmission if all variable factors were disregarded. Free space loss depends only on the frequency and the distance between antennas.

X2.3.1.185 **frequency**—the number of cycles, repetitions, or oscillations of a periodic process completed during a unit of time. The frequency of waves in the electromagnetic spectrum (radio waves) is designated in hertz (Hz), kilohertz (kHz = 1000 Hz). One hertz is equivalent to one cycle per second.

X2.3.1.186 **frequency band**—a continuous range of frequencies extending between two limiting frequencies.

X2.3.1.187 **frequency coordination**—see **coordination**, **frequency**.

X2.3.1.188 **frequency deviation**—frequency deviation of an FM signal is the change in the carrier frequency produced by the modulating signal. The frequency deviation is proportional to the instantaneous amplitude of the modulating signal.

X2.3.1.189 **frequency modulation (FM)**—a method of modulating a carrier-frequency signal by causing the frequency to vary above and below the unmodulated value in accordance with the intelligence signal to be transmitted. The amount of deviation in frequency above and below the resting frequency is at each instant proportional to the amplitude of the intelligence signal being transmitted. The number of complete deviations per second above and below the resting frequency corresponds at each instant to the frequency of the intelligence signal being transmitted.

X2.3.1.190 **frequency response**—the transmission loss or gain of a system, measured over the useful bandwidths, compared to the loss or gain at some reference frequency (generally 1000 Hz).

X2.3.1.191 **fresnel zone**—the circular zone about the direct path between a transmitter and a receiver at such a radius that the distance from a point on this circle to the receiving point has a path length that is some multiple of a half wave length longer than the direct path.

X2.3.1.192 **fringe area**—an area or locality at such a distance from the transmitter that the signals received are weak.

X2.3.1.193 **full-duplex operation**—a method of operation of a radio system that provides simultaneous two-way communications between two points. In EMS radio systems, provides for mutual interrupt capabilities between the field technician and the physician or medical direction at a hospital location.

**G**

X2.3.1.194 **gain, of an antenna**—the effectiveness of a directional antenna in a particular direction, compared against a standard (usually an isotopic antenna). The radio of standard antenna power to the directional antenna power that will produce the same field strength in the desired direction.

X2.3.1.195 **generator, standby power**—a device that develops electrical voltage from mechanical energy. An ac electrical power source held in reserve and used to supply the necessary ac power when commercial power fails.

X2.3.1.196 **generator, signal**—a portable test oscillator that can be adjusted to provide a test signal at some desired frequency, voltage, modulation, or waveform.

X2.3.1.197 **geographical assignment**—the assignment and use of communications channels on a dedicated used basis within a given geographic area.

X2.3.1.198 **GHz**—gigahertz (billion hertz, 1000 MHz).

X2.3.1.199 **gin pole**—a pole which is used together with ropes and pulleys as a derrick for lifting heavy loads and for erecting poles or towers.

X2.3.1.200 **ground**—a reference point. Also a connection, intentional or accidental, between an electrical circuit and the earth or its equivalent.

X2.3.1.201 **ground plane antenna**—a type of vertical transmitting or receiving antenna used primarily for short wavelength or high band communications. A ground plane antenna consists of a quarter-wave vertical element, and four radial elements spaced 90° apart, and mounted on the base of the vertical element. Antennas of this type are nondirectional and have a low angle of radiation.

X2.3.1.202 **ground wire**—a conductor leading from the radio equipment to an electrical connection with the ground.

X2.3.1.203 **guard band**—a narrow band of frequencies provided between adjacent channels in certain portions of the radio spectrum to prevent interference between stations.

X2.3.1.204 **guy anchor**—the buried weight or mass to which the lower end of a guy wire is attached.

**H**

X2.3.1.205 **half-duplex channel**—a communication channel providing duplex operation at one end of the channel, but not the other. Sometimes, the base station is operated in the duplex mode; however, in EMS, the portable or mobile radio is often operated in the duplex mode, and the base station at the hospital operated simplex, to permit the medical direction physician to interrupt transmissions from the field technician. See also **simplex**.

X2.3.1.206 **half-duplex operation**—generally refers to the ability of directing medical personnel in EMS radio system to interrupt or 'break in' on radio transmissions from field personnel to give instructions or ask questions. Sometimes referred to as "physician interrupt." Requires duplexed communications equipment in the field.

X2.3.1.207 **half-wave dipole antenna**—a straight, ungrounded antenna having an electrical length equal to half the wave length of the signal being transmitted or received. Mounted vertically, it has a donut-shaped pattern, circular in the horizontal plane.

X2.3.1.208 **ham**—a term applied to an amateur radio operator, as opposed to business or commercial operators. A person that makes amateur radio operation a hobby.

X2.3.1.209 **harmful interference**—any emission, radiation, or induction that endangers the functioning of a radio service or seriously degrades, obstructs, or repeatedly interrupts a radio communication service.

X2.3.1.210 **hand microphone**—a microphone designed to be held in the hand. Sometimes called a "palm" microphone.

X2.3.1.211 **handset**—a device similar to a telephone handset used in place of a hand microphone.

X2.3.1.212 **hardcopy**—a tangible printed copy of a message such as that obtained from a teleprinter.

X2.3.1.213 **hardware**—the screws, nuts, clamps, anchors, connectors, and so forth, used in the installation and maintenance of communications systems.

X2.3.1.214 **hardwire**—to wire or cable directly between units of equipment without passing through other media.

X2.3.1.215 **harmonic**—an integral multiple of a fundamental frequency. The third harmonic of 20 Hz is 60 Hz. The fifth harmonic of 40 Hz is 200 Hz.

X2.3.1.216 **hash**—noise signal produced by an electrical or mechanical source.

X2.3.1.217 **headphone**—a device that can be placed on the head to allow individual listening to messages.

X2.3.1.218 **HEAR**—Hospital Emergency Administrative Radio—Motorola Communications and Electronics trade name for a VHF radio system operating on standard frequencies with a selective calling system between stations. The system is similar to General Electric Mobile Radio Departments EACOM radio system.

X2.3.1.219 **helix**—a single-layer, spiral wound coil usually having air or foamed polyethylene core.

X2.3.1.220 **hetrodyne**—(1) pertaining to the production of difference in frequencies (beat frequencies) by the combination of the two frequencies and (2) to shift an incoming radio signal to a different frequency, often to a lower intermediate frequency.

X2.3.1.221 **Hetordyne frequency**—the beat frequency, which is the sum or difference between two frequency signals.

X2.3.1.222 **hertz (Hz)**—international unit of frequency identical to and used instead of the old term cycles. One hertz is equal to one cycle per second.

X2.3.1.223 **high band**—a portion of the VHF radio frequency spectrum from 150 to 174 MHz in which two-way radio operates.

X2.3.1.224 **hollerith code**—a twelve-level code which defines the relation between an alphanumeric character and the punched holes in an 80-column data card.

X2.3.1.225 **hookswitch**—the device on which a handset or microphone hangs when not in use. The handset operates a switch, or switches, that open the associated circuits.

X2.3.1.226 **hop**—(*1*) the number of reflections from the ionosphere encountered by the radio wave in traveling from the transmitter to the receiver and (*2*) the number of radio links required to span a given path.

X2.3.1.227 **hot line**—direct circuit between two or more points for immediate use without patching or switching. (See direct leased land lines.) The hot line can use various signalling configurations (that is, ringdown, audio amplifier, and so forth).

X2.3.1.228 **hot standby operation**—a method of achieving reliable operation by energizing two identical equipments fed by and to a switchable input and output. A sensing device causes transfer of input and output circuits when a failure is indicated.

X2.3.1.229 **hum**—audio frequency interference which is at the frequency of the power supply or its harmonics.

X2.3.1.230 **humidity, relative**—the ratio of the amount of water vapor the air contains to the maximum amount it could hold at the same temperature and pressure expressed in percent.

X2.3.1.231 **hybrid**—(1) made up of several different components or a mixture of technologies. (2) A circuit required to convert four-wire operation to two wire, while maintaining isolation of the four-wire circuit.

**I**

X2.3.1.232 **ignition noise**—interference produced by sparks or other ignition discharged in a vehicle.

X2.3.1.233 **image**—one of the two groups of sidebands generated in the process of modulation, so called because one is the reverse (mirror image) of the other with respect to operating frequency.

X2.3.1.234 **image frequency**—in hetrodyne frequency converters, an undesired input frequency that can beat with the local oscillator to produce the intermediate frequency and thus appear in the receiver output.

X2.3.1.235 **image rejection**—the action of a receiver in suppressing the image frequency.

X2.3.1.236 **impedance** —the total resistance that a circuit offers to the flow of alternating current. Impedance is a combination of resistance and reactance. The ohm is used as a unit of impedance measurement.

X2.3.1.237 **impedance match**—the condition in which the impedance of one component is the same as the component to which it is connected or attached.

X2.3.1.238 **impedance, characteristic**—the importance of characteristic impedance lies in the fact that when a transmission line is terminated, as with an antenna, in an impedance matching its own, then all of the energy or power flowing along the line is radiated by the antenna. If the impedance of the termination (antenna) is not matched to the transmission line, a portion of the energy will be reflected at the mismatch resulting in a lower output from the antenna.

X2.3.1.239 **Improved Mobile Telephone Service (IMTS)**—a mobile radio telephone offering of a telephone company.

X2.3.1.240 **impulse**—a surge of electricity having a single polarity.

X2.3.1.241 **indicator**—a device used to inform of a condition or change in condition.

X2.3.1.242 **induced**—produced as a result of exposure to a changing electric or magnetic field.

X2.3.1.243 **Industrial Radio Service**—an FCC-designated radio service.

X2.3.1.244 **in-band signaling**—the transmission of signaling tones within the frequency band of the channel.

X2.3.1.245 **insertion loss**—the loss introduced when a device or line section is interposed between two elements of a circuit.

X2.3.1.246 **insulation**—any nonconductive material used to prevent the leakage of electricity from a conductor, such as rubber, glass, mica, and so forth.

X2.3.1.247 **integrated circuit**—a complete circuit consisting of transistors, capacitors, resistors, diodes, and so forth that is formed on a single semiconductor substrate.

X2.3.1.248 **Integrated Circuit Oscillator Module (ICOM)**—a frequency determining circuit used in General Electric radios containing a crystal oscillator circuit and other circuits used to generate the oscillator frequency.

X2.3.1.249 **interface**—a concept involving the specification of the interconnection between two equipments or systems. The specification includes the type, quantity, and function of the interconnection circuits and the type and form of the signals to be interchanged via these circuits.

X2.3.1.250 **interference**—interference in a signal transmission path is either extraneous power which tends to interfere with the reception of the desired signals or the distribution of signals which results in loss of signal or distortion of information.

X2.3.1.251 **intermittent**—not continuously present; disappearing and reappearing.

X2.3.1.252 **intermittent duty cycle**—a duty cycle of 1 min on, 4 min off, or 20 % per electronic industries association (EIA).

X2.3.1.253 **intermodulation**—the combination of two signals beating together to form a third unusable signal that interferes with reception of the desired signal. In a radio receiver the method of expressing in dB below the desired signal, the receiver's rejection of the unwanted signal to its acceptance of correct signals.

X2.3.1.254 **intrinsically safe**—a laboratory (UL) rating for equipment considered approved to operate in areas in which hazardous concentrations of flammable gases exist.

X2.3.1.255 **inverter**—(*1*) any of several devices used to convert direct current to alternating current, (*2*) a single input, single output device that changes the polarity of (inverts) a signal when passing it from input to output. A negative signal at the input produces a positive signal at the output and vice versa. A differential EKG amplifier has a normal and an inverting input.

X2.3.1.256 **ionosphere** —the upper portion of the earth's atmosphere beginning at about 50 miles above the surface of the earth; the cause of radio signals being bent, and returned to earth.

X2.3.1.257 **isolator**—a passive RF device that permits transmission in only one direction, absorbing energy in the opposite direction.

**J**

X2.3.1.258 **jack**—a connecting device ordinarily used to make electrical contact with mating contacts of a plug.

X2.3.1.259 **jacket**—the outer covering on an insulated wire or cable.

X2.3.1.260 **jamming**—the deliberate radiation, reradiation, or reflection of electromagnetic energy with the object of impairing the use of electronic devices, equipment, or systems.

X2.3.1.261 **jumper**—a short length of conductor used to bridge electrical connections.

X2.3.1.262 **junction box**—a metal or other container into which wires or cables are led and connected.

**K**

X2.3.1.263 **key**—a push-to-operate switch used for operating a transmitting circuit in a radio system.

X2.3.1.264 **key telephone equipment**—an instrument that has the capability of multiple line terminations. Each line is accessed by depressing an association button (key).

X2.3.1.265 **keypunch**—a machine controlled by a typewriter-like keyboard that enables an operator to punch holes in predescribed places in a hollerith code.

X2.3.1.266 **kilo**—a prefix meaning one thousand.

X2.3.1.267 **kbps**—thousands of bits per second.

X2.3.1.268 **kilohertz (kHz)**—equal to 1000 cycles per second. Replaces the term kilocycle.

X2.3.1.269 **klystron**—an electron tube in which the electrons are periodically bunched by electric fields. Used as an RF oscillator for microwave equipment.

X2.3.1.270 **knockout**—a metal disk punched in the side of a metal terminal junction box or cabinet which can be punched out to allow entry of a cable or conduit.

**L**

X2.3.1.271 **land line**—a generic term which refers to the public-switched telephone system.

X2.3.1.272 **lag**—the difference in phase angle expressed in electrical degrees between the voltage and current that produced it.

X2.3.1.273 **land-mobile**—an abbreviation for land to mobile communications such as between base stations and mobile radios or from mobile radio to mobile radio.

X2.3.1.274 **Land Mobile Radio Service**—a mobile radio service defined by the Federal Communications Commission—FCC Rules and Regulations Part 90.

X2.3.1.275 **LATA**—local access and transport area boundaries for telephone companies. The geographic area within which the local telephone company provides local and long distance service.

X2.3.1.276 **Law Enforcement Assistance Administration (LEAA)**—an administration under the United States Department of Justice established by the Omnibus Crime Control and Safe Streets Act of 1968, restructured by the Justice Improvement Act of 1979 and abolished two years later.

X2.3.1.277 **leased line**—a pair of wires or a circuit, usually leased or rented from a telephone company, designed for exclusive use between two fixed points for various communication control functions.

X2.3.1.278 **life cycle**—a test performed on a material device to determine the length of time before failure.

X2.3.1.279 **line**—a transmission line or power line. A system of one or more wires.

X2.3.1.280 **linear**—describing a device in which the signal output voltage is directly proportional to the signal input voltage. A straight line relationship.

X2.3.1.281 **line, balanced**—a two-wire line that has identical impedance from each wire.

X2.3.1.282 **line equalizer**—a connection in series with a telephone line that will alter the frequency response characteristics of the line.

X2.3.1.283 **line, four-wire**—a two-way transmission circuit using separate paths for transmit and receive functions.

X2.3.1.284 **line, lossy**—a transmission line, usually a coaxial cable, that is designed to have very high transmission loss per unit length. Used in tunnels, underground, or buildings for radio communications systems.

X2.3.1.285 **line of sight**—an unobstructed path between two points. Radio waves at those frequencies where signals travel in a straight line and are not reflected by the ionosphere.

X2.3.1.286 **line-of-sight distance**—the straight-line distance from a radio station antenna to horizon. This represents the normal transmitting range of FM transmitting stations.

X2.3.1.287 **link**—the portion of a radio relay system between adjacent radio stations.

X2.3.1.288 **load**—(*1*) a device that receives power from a transmission system and (*2*) the amount of electric power drawn by an electric or electronic device.

X2.3.1.289 **load, dummy**—a device that can dissipate energy (into heat) without radiating it.

X2.3.1.290 **loading, antenna**—insertion of reactance in an antenna circuit to improve its transmission characteristic in a given frequency band.

X2.3.1.291 **loading, ice**—the stress imposed on an antenna or antenna structure caused by ice forming on its members.

X2.3.1.292 **loading, wind**—the stress imposed on an antenna or antenna structure caused by wind.

X2.3.1.293 **lobe**—one of the three-dimensional petals representing the radiation or reception efficiency of a directional antenna.

X2.3.1.294 **local government radio service**—a service of radio communication defined by the FCC essential to official activities of states, possessions, and territories, including counties, towns, cities, and similar governmental subdivisions.

X2.3.1.295 **local service area**—that area that can be called on the telephone without incurring multimessage units or a toll charge.

X2.3.1.296 **log**—a list of radio stations showing frequency, location, power, and other data. Also a communication record for a station showing calls made, time, date, and other data. A detailed record.

X2.3.1.297 **loop**—(*1*) a short transmission line that connects a subscriber to a switchboard and (*2*) a closed path in which a signal may circulate. This path may be within a piece of equipment, such as a repeater or carrier terminal, or may be a complete carrier circuit.

X2.3.1.298 **loop resistance**—the resistance presented to the signaling portion of the terminating set by the wireline when the far end of the wireline is short circuited.

X2.3.1.299 **loss**—a decrease in power suffered by a signal as it is transmitted from one point to another, usually expressed in decibels. Energy dissipated without accomplishing useful work.

X2.3.1.300 **loss, free space**—the theoretical transmission loss between two radio antennas dependent only upon distance and frequency.

X2.3.1.301 **loss, path**—the reduction or attenuation of signal strength that occurs between the transmitted strength and the received signal strength.

X2.3.1.302 **low band**—a section of the VHF radio frequency spectrum from 25 to 50 MHz in which mobile radio equipment is licensed to operate.

X2.3.1.303 **low loss**—describing circuits and transmission line in which little energy is lost from the input to the output.

X2.3.1.304 **lower sideband**—the lower of two frequencies or of two groups of frequencies produced by a modulation process.

X2.3.1.305 **lug, spade**—a connector which has an open end to slip under a terminating screw.

**M**

X2.3.1.306 **marginal**—operating at the borderline of permissible limits.

X2.3.1.307 **matrix**—an array of horizontal and vertical input or output leads with cross points at the intersections, used as a means of switching from any input to any output.

X2.3.1.308 **mean**—the arithmetic middle point of a range of values, obtained by adding the highest and lowest values and dividing by two.

X2.3.1.309 **median**—the point below which there are as many instances as there are above.

X2.3.1.310 **medical communications control console**—an installation of communications control equipment, usually located at a hospital, which provides for control of the transmitting and receiving equipment necessary for the medical communications.

X2.3.1.311 **microwave**—a term applied to radio waves in the frequency range of 1000 MHz and upward. Microwave radio generally performs the same functions as telephone cables and may be used for radio remote control purposes.

X2.3.1.312 **mobile**—term used to describe equipment designed for vehicular installation.

X2.3.1.313 **mobile relay station**—a fixed station established for the automatic retransmission of mobile service radio communications that originate on the transmitting frequency of the mobile stations and are retransmitted on the receiving frequency of the mobile stations.

X2.3.1.314 **mobile repeater station**—a mobile station in the mobile service authorized to retransmit automatically on a mobile service frequency communications originated by handheld or portable units or by other mobile or base stations directed to such hand-carried units.

X2.3.1.315 **mobile service**—a service of radio communications between mobile and land stations, or between mobile stations.

X2.3.1.316 **mobile station**—a two-way radio station in the mobile service intended to be used while in motion or during halts at unspecified points.

X2.3.1.317 **mobile telephone service (MTS)**—telephone service between a fixed mobile radio base station and several vehicles equipped with mobile radios.

X2.3.1.318 **mobile transmitter** —a radio transmitter designed for installation in a vehicle, vessel, or aircraft and normally operated while in motion.

X2.3.1.319 **mobile unit**—a two-way radio equipped vehicle or person. Also, sometimes the two-way radio itself, when associated with a vehicle or person.

X2.3.1.320 **modem**—contraction of modulator-demodulator.

X2.3.1.321 **modular**—a construction technique incorporating the use of standard size units for interchangeability.

X2.3.1.322 **modulate**—to vary the amplitude (AM), frequency (FM), or phase of a high-frequency wave or carrier in step with amplitude variations of another wave (the modulating wave). The carrier is usually a sine wave while the modulating wave is often a complex voice or EKG signal.

X2.3.1.323 **modulator**—the electronic circuit that combines the modulating wave with the carrier wave. In radio transmitters, the final audio-frequency stage that mates the audio signal with the carrier signal. In EKG telemetry, the circuit that combines the amplified EKG signal with the subcarrier (audio) signal for transmission by radio or telephone.

X2.3.1.324 **multichannel system**—a radio system that uses more than one radio channel. Also known as a multifrequency system.

X2.3.1.325 **multicoupler, receiver**—a device that permits several radio receivers to use the same antenna. Usually a broadband amplifier with several output ports.

X2.3.1.326 **multifrequency operation**—using radio equipment capable of operation on two or more frequencies.

X2.3.1.327 **multijurisdictional system**—a system covering more than one political boundary or agency.

X2.3.1.328 **multipath**—the propagation phenomenon that results in signals reaching a radio receiving antenna by two or more paths usually resulting in a degradation of the original signal.

X2.3.1.329 **multiplex**—transmitting two or more signals over the same medium. In EKG telemetry equipment, the ability to transmit electrocardiograph (EKG) signals and voice signals concurrently over the same transmitter.

X2.3.1.330 **multiplex, frequency division**—a multiplex system in which the total transmission bandwidth is divided into narrower bands each used for a single separate channel.

X2.3.1.331 **multiplex, time division**—a method of multiplexing in which the total frequency spectrum available is used by each channel, but only for part of the time. A sharing of transmission ability, first by one parameter, then by another.

X2.3.1.332 **multitone**—a method of signaling that involves two or more tone signals produced simultaneously or sequentially.

X2.3.1.333 **mute**—to silence or reduce sound level.

**N**

X2.3.1.334 **netting**—the process of adjusting a system's transmitters and receivers to the same operating frequencies.

X2.3.1.335 **net loss**—the algebraic sum of the gains and losses between two terminals of a circuit.

X2.3.1.336 **network**—an orderly arrangement of stations interconnected through communications channels to form a coordinated entity.

X2.3.1.337 **nine-one-one (9-1-1)**—a three-digit emergency telephone number accepted and promulgated by the telephone industry as the nationwide emergency number.

X2.3.1.338 **Nxx**—the first three digits of a local telephone number that uniquely identifies that central office switching location within its area code number for nationwide long distance call routing.

X2.3.1.339 **noise**—interference characterized by undesirable random voltages caused by an internal circuit defect or from some external source. Any extraneous signal tending to interfere with the proper and easy perception of those signals which are intended to be received.

X2.3.1.340 **noise blanker**—a device used in mobile radio applications that senses the presence of undesired noise on the desired channel and causes the desired signal to be interrupted for the time period that the undesired noise signal is present. The time period is controlled and measured in milliseconds so that the interruption of the desired signal is not audible.

X2.3.1.341 **noise level**—volume of noise usually expressed in decibels.

X2.3.1.342 **noise limiter**—a circuit that cuts off the noise peaks that are stronger than the highest peak of the desired signal being received.

X2.3.1.343 **nomograph**—a chart having three or more scales across which a straightedge can be placed to provide a graphical solution for a particular problem. In mobile radio nomographs may be used to determine frequency spread, estimated radio range, antenna height, and so forth.

**O**

X2.3.1.344 **octave**—the interval between two frequencies having a ratio of two to one.

X2.3.1.345 **ohm**—an electrical unit of resistance.

X2.3.1.346 **ohm's law**—the current in an electric circuit is directly proportional to the electromotive force in the circuit. In the form $E = I*R$, where $E$ is the electromotive force (voltage), $I$ is the current (amperage), and $R$ is the resistance of the circuit (ohms).

X2.3.1.347 **omnidirectional**—equally effective in all directions.

X2.3.1.348 **open**—a break in circuit continuity.

X2.3.1.349 **outage**—a disruption of communications from any cause, whether planned or accidental.

X2.3.1.350 **out-of-band signaling**—transmission of signals by frequencies outside of the voice band.

X2.3.1.351 **overload**—a load greater than a device is designed to handle.

**P**

X2.3.1.352 **paging**—a one-way communications service from a base station to mobile or fixed receivers that provide signaling or information transfer by such means as tone, tone-voice, tactile, optical readout, and so forth.

X2.3.1.353 **pair**—two wires of a signal circuit generally applied to telephone wherein one wire is designated "tip" and the second wire "ring."

X2.3.1.354 **passive**—a device that does not contribute energy to the signal it passes.

X2.3.1.355 **passive repeater** —a device intentionally interposed in a microwave transmission path to redirect or reflect energy.

X2.3.1.356 **patch**—a means of connecting one system to another. A patch may be between radio systems, or radio to telephone, as in a radio/phone patch.

X2.3.1.357 **path, signal**—the route by which intelligence is conveyed from transmitter to receiver or through a circuit.

X2.3.1.358 **personal radio**—a small portable radio intended to be carried by hand or on the person of the user.

X2.3.1.359 **PERT**—program evaluation and review technique. A management tool for comparing actual with scheduled program progress.

X2.3.1.360 **phase**—the position at any instant which the periodic wave occupies in its cycle of 360°.

X2.3.1.361 **phone patch**—an interconnection between radio and telephone communications circuits which permits direct voice interchange between telephone lines and radio system.

X2.3.1.362 **pigtail**—a splice made by twisting together the bared ends of two conductors.

X2.3.1.363 **plug-in**—describing any device having terminals so it can be connected by simply pushing it into a suitable socket or connector.

X2.3.1.364 **portable**—an easily transportable radio.

X2.3.1.365 **primary power**—a reliable source of electrical power normally serving as the principle source of energy to equipment, such as the commercial 120-V ac power main.

X2.3.1.366 **private automatic branch exchange (PBX)**—a telephone switchboard with many stations not individually identifiable to the telephone company's switching network requiring an operator.

X2.3.1.367 **private line (PL)**—Motorola's trademarked name for continuous tone-controlled squelch system, CTCSS.

X2.3.1.368 **propagation, electromagnetic**—the travel of electromagnetic waves through a medium or the travel of a sudden electric disturbance along a transmission line. Also called wave propagation.

X2.3.1.369 **protect**—to equip with devices for safeguarding from damage by excessive voltages, current, or physical abuse.

X2.3.1.370 **public safety agency**—a functional division of a public agency that provides fire fighting, police, ambulance, emergency medical, or other emergency services.

X2.3.1.371 **public safety answering point (PSAP)**—the initial answering location of a 9-1-1 call and other calls for assistance.

X2.3.1.372 **public safety telecommunicator**—an individual trained to communicate by electronic means with persons seeking emergency assistance and with agencies and individuals providing such assistance.

X2.3.1.373 **pull box**—a box with a removable cover installed in a conduit run to facilitate pulling wire or cable into the conduit.

X2.3.1.374 **pulse**—a signal of short duration.

X2.3.1.375 **pulsed tone**—a system of selective signaling using a keyed on-off tone signal.

X2.3.1.376 **push-to-talk or press-to-talk (PTT)**—in radio or telephone systems, that method of communication over a speech circuit in which transmission occurs from only one station at a time, the talker being required to keep a switch operated while he is talking. The keying button used to operate a radiotelephone transmitter.

**Q**

X2.3.1.377 **quarter-wave antenna**—an antenna electrically equal to one fourth of the wavelength of the signal to be transmitted or received.

X2.3.1.378 **quartz**—an element consisting of pure silicon dioxide. The original piezoelectric material widely used to control the frequency of oscillators.

X2.3.1.379 **quartz crystal**—a thin square or rectangular slice of quartz which will vibrate at a frequency determined by its thickness.

X2.3.1.380 **quiet channel**—RCA Corporation's trademarked name for continuous tone-controlled squelch system (CTCSS).

X2.3.1.381 **quieting**—reduction of system noise.

X2.3.1.382 **quick-call**—Motorola Communications Company trademarked name for a system of selective calling, normally using two pairs of two tones each in sequence. Quick Call II uses a pair of sequential tones similar to General Electric's Type 99 tone system.

**R**

X2.3.1.383 **rack mounting**—a method of mounting equipment in which metal panels supporting the equipment are attached to predrilled steel channel rails or racks. The dimensions of the panels, the spacing of the rails, and the size of the mounting screws are standardized.

X2.3.1.384 **rack unit**—in mobile radio, generally a rack mounting 19 in. between rails and a height of 1.75 in. per unit.

X2.3.1.385 **radio**—the transmission and reception of signals by means of electromagnetic waves without a connecting wire.

X2.3.1.386 **radio-frequency power**—the power associated with any signal consisting of electromagnetic radiation which is used for telecommunications.

X2.3.1.387 **radio interference** —undesired disturbance of radio reception. Man-made interference is generated by electric devices, with the resulting interference signals either being radiated through space as electromagnetic waves or traveling over power lines or other conducting media. Radio interference is also due to natural sources such as atmospheric phenomena, such as lightning. Radio transmitters themselves may additionally interfere with each other.

X2.3.1.388 **radio network**—a number of radio stations, fixed and mobile, in a given geographical area that are jointly administered or communicate with each other by sharing the same radio channel or channels.

X2.3.1.389 **radio common carrier (RCC)**—an enterprise that is licensed by the FCC and Public Utilities Commission to provide radio communications service to the public.

X2.3.1.390 **radio receiver**—an instrument that amplifies radio frequency signals, separates the intelligence signal from the rf carrier, amplifies the intelligence signal additionally, and converts the intelligence signal to its original form.

X2.3.1.391 **radio relay system (radio relay)**—a point-to-point radio transmission system in which the signals are received and retransmitted by one or more intermediate radio stations.

X2.3.1.392 **radio transmitter**—a radio-frequency power source that generates radio waves for transmission through space.

X2.3.1.393 **radome**—a dome-shaped cover for a parabolic antenna that protects the antenna from the elements and their attenuating effects.

X2.3.1.394 **range**—distance over which a radio signal can be transmitted for effective reception or the distance at which a usable signal can be received.

X2.3.1.395 **receiver**—an electronic device used to detect and amplify transmitted radio signals.

X2.3.1.396 **receiver, paging**—a small, light, pocket-sized receiver used for alerting individuals when they are away from their normal communication instruments.

X2.3.1.397 **referral method**—the calling party to a public safety answering point is referred to a secondary telephone number.

X2.3.1.398 **refraction**—the change of direction experienced by a wave of any form of radiated energy when passing from one medium to another having a different dielectric constant or index of refraction.

X2.3.1.399 **regional EMS system**—an emergency medical service area (trade, catchment, market, patient flow, geographic, or governmental) that provides essentially all of the definitive emergency medical care for all emergencies and for the most critically ill and injured patients within the area.

X2.3.1.400 **relay**—transmission forwarded through an intermediate station.

X2.3.1.401 **relay station**—radio stations that rebroadcast signals the instant they are received, so that the signal can be passed on to another station outside the range of the originating transmitter.

X2.3.1.402 **reliability**—the ability of an item to perform a required function under stated conditions for a stated period of time.

X2.3.1.403 **remote base station**—a base station located away from the operating console to take advantage of improved coverage offered by a better geographical location.

X2.3.1.404 **remote control**—the operation of a device from a distance either electrically or by radio waves.

X2.3.1.405 **remote control equipment**—the apparatus used for performing monitoring, controlling, supervisory control, or a combination of these functions at a distance by electrical means.

X2.3.1.406 **repeater**—a combination of apparatus for receiving either one-way or two-way communication signals and delivering corresponding signals which are either amplified or reshaped or both.

X2.3.1.407 **repeater station**—an operational fixed station established for the automatic retransmission of radio communications received from any station in the mobile service.

X2.3.1.408 **repeater station, remodulating**—a microwave repeater station in which the signal is demodulated to the original baseband frequencies and reinjected onto the modulator for transmission to the distant station.

X2.3.1.409 **resource management center**—a center responsible for the allocation of those resources essential to the most effective and efficient resolution, or management or both, of the immediate problem. In most communities these resources include police, fire and emergency medical services. The resource management center is most effective when its responsibilities encompass the whole of public safety response.

X2.3.1.410 **ringback**—in a public safety answering center, permits the answering point to ring the hung-up telephone on a held circuit. The feature is useful when a calling party has failed to provide all necessary information to the answering point before hanging up.

X2.3.1.411 **ringdown**—a type of signaling used in manual operation telephone (as compared to dial) which uses a continuous or pulsing ac signal transmitted over the line.

**S**

X2.3.1.412 **schematic diagram**—a diagram or drawing that shows electrical connections of a radio or other electrical device by means of symbols which are used to represent the components.

X2.3.1.413 **search lock monitor**—a receiver channel scanning scheme that locks the receiver on the first channel received.

X2.3.1.414 **selective call**—a system for alerting individual or groups of stations by means of coded signals.

X2.3.1.415 **selectivity**—the ability to select one particular signal from other signals at nearby frequencies. This specification is important in urban areas where radio spectrum congestion exists. The more negative the dB rating, the better the specification.

X2.3.1.416 **selective routing**—a routing of telephone call to terminate at a PSAP determined by the location of the calling telephone. This is accomplished by using a computer to process the calling telephone number.

X2.3.1.417 **sensitivity**—the characteristic of a radio receiver which determines the minimum input signal strength required for a given signal output. In FM, sensitivity is the signal level required to produce a given ratio of signal to noise. The more sensitive a receiver is, the weaker the signal it can receive.

X2.3.1.418 **service channel**—in a microwave system, a voice channel fused for maintenance and fault location. Also called an order wire.

X2.3.1.419 **service life**—the life expectancy of equipment under normal conditions of use.

X2.3.1.420 **side tone**—the signal that reaches a telephone receiver from the transmitter of the same set by way of a local path within the set.

X2.3.1.421 **signal**—the form of a radio wave in relation to the frequency serving to convey intelligence in communication.

X2.3.1.422 **signal-to-noise ratio**—the ratio of the intensity of the desired signal to that of the undesired noise signal, usually expressed in decibels.

X2.3.1.423 **signal strength**—a measure of the field intensity caused by a radio transmitter at a particular location within its operating range. Usually expressed as microvolts or millivolts of signal.

X2.3.1.424 **simplex**—(*1*) single frequency operation whereby all base stations and mobiles operate on one common frequency and (*2*) operation on two different frequencies in a system that can communicate in two directions, but not simultaneously, such as when a base station and a mobile radio operate on reversed pairs of frequencies without duplexing.

X2.3.1.425 **simplex channel**—a communication channel providing transmission in one direction only at any given time. For comparison see duplex channel.

X2.3.1.426 **simplex operation**—a method of radio operation in which communication between two stations takes place in only one direction at a time. This includes ordinary transmit-receive operation, press-to-talk operation, voice-operated transmit, and other forms of manual or automatic switching from transmit to receive. Also called simplex.

X2.3.1.427 **SINAD**—the ratio of signal plus noise plus distortion to the noise plus distortion; expressed in decibels. An EIA standard method of measuring receiver sensitivity. Basically a measure of RF signal strength that will result in a readable signal.

X2.3.1.428 **siren**—an acoustical or electromechanical device used as a warning signal on emergency vehicles.

X2.3.1.429 **software**—the programs or instructions required to use a computer or data processing device.

X2.3.1.430 **solid state**—denoting the use of semiconductors instead of vacuum tubes or relays.

X2.3.1.431 **Special Emergency Radio Service (SERS)**—that portion of radio communications frequency resources

authorized by the FCC for use in the alleviation of emergency situations endangering life or property. See FCC Part 90.

X2.3.1.432 **spectrum**—a continuous range of frequencies arranged in order of wavelength or frequency within which waves have some common characteristics, such as audio spectrum, radio spectrum, and so forth. The entire range of electromagnetic radiation extending from the longest known radio waves to the shortest known cosmic rays.

X2.3.1.433 **spurious response**—the response of a radio receiver to an undesired frequency.

X2.3.1.434 **squelch**—a circuit function that acts to suppress the audio output of a receiver when noise power exceeding a predetermined level is present.

X2.3.1.435 **squelch, carrier**—a squelch system that responds to the presence of an RF carrier signal.

X2.3.1.436 **squelch circuit**—a circuit that reduces or lowers the noise that would otherwise be heard in a radio receiver between transmissions.

X2.3.1.437 **stability, frequency**—the ability of a radio transmitter to maintain any predetermined frequency, such as its assigned frequency. Measured in percent of the carrier. The lower the percentage the better the stability.

X2.3.1.438 **standing wave ratio (SWR)**—a measure of the amount of lost transmitting power as a result of impedance differences between the transmission line and the antenna. The ratio of reflected to incident waves that exists at some particular point on a transmission line.

X2.3.1.439 **statewide EMS system**—a network of EMS systems, integrated and coordinated at the state level.

X2.3.1.440 **strip chart recorder**—an electromechanical device used to make paperchart recordings of EKG information. Usually it uses a heat-sensitive paper and a heated stylus.

X2.3.1.441 **subcarrier**—a frequency sensitive device used to generate a modulated wave which in turn is applied as a modulating wave to modulate another carrier. For EMS telemetry, the subcarrier frequency is 1400 Hz.

X2.3.1.442 **supergroup**—in microwave systems, groups of 60 channels each, occupying a particular range of frequencies.

X2.3.1.443 **switched network**—a complex of diversified channels and equipment that automatically routes communications between the calling and called person or data equipment. The public telephone system.

X2.3.1.444 **synthesizer, frequency**—a highly precise crystal oscillator with frequency dividers used to provide the precise radio frequency. A typical synthesizer can be set to small frequency increments and have an accurate output at the desired output frequency.

X2.3.1.445 **synchronization**—the process of making the carrier at the receiving end of a line or system match the frequency of the carrier at the transmitting end.

X2.3.1.446 **system** —a combination of two or more stations in such a way as to provide communications.

**T**

X2.3.1.447 **tandem trunking**—an arrangement in which a telephone-line connection has one or more intermediate points that are required or permitted usually on a controlled dial pulse basis before reaching the final destination (called) party.

X2.3.1.448 **tariff**—a document filed by a communications company with the Public Utilities Commission which lists the services offered the public and a schedule of rates and charges.

X2.3.1.449 **tarnish**—a discoloration or stain on the surface of metal caused by exposure to chemicals or the atmosphere. To dull or destroy the luster of metal.

X2.3.1.450 **tee**—a three-way connection in the shape of the letter *t*.

X2.3.1.451 **telecommunicator**—see public safety telecommunicator.

X2.3.1.452 **telecommunications**—all forms of electrical transmission of intelligence including: telegraph, telephone, radio, and television. Pertaining to the art and science of communication by these methods.

X2.3.1.453 **telemetry**—the sensing and measuring of information at some remote location and transmitting the data to a convenient location to be read and recorded.

X2.3.1.454 **telpak**—an acronym for “telephone package” a schedule of bulk discount rates for multiple private line telephone services such as AT&T long-lines series 500 tariff offering.

X2.3.1.455 **telephone line**—a telephone line from a telephone company central office that is connected to key or nonkey telephone equipment.

X2.3.1.456 **teletypewriter**—an electromechanical device, similar to a typewriter, such that messages typed on the keyboard of the transmitter unit are converted into electrical signals, which when conveyed to the receiver unit, are printed on paper.

X2.3.1.457 **ten signals**—a series of coded messages designed to reduce air transmission time and confusion in busy mobile radio systems.

X2.3.1.458 **thermal noise**—very small noise voltages that are present in all conductors, caused by the thermal agitation of charged particles within the conductor.

X2.3.1.459 **third harmonic**—a frequency wave having three times the fundamental frequency value.

X2.3.1.460 **threshold**—in an FM receiver, the point at which the peaks of the incoming RF signal exactly equal the peaks of the internally generated thermal noise power or the point above which increasing the input signal strength provides only a dB for dB improvement in the output signal-to-noise ratio.

X2.3.1.461 **tip** —the ball-shaped contact on the cord (tip) of a plug. One of a pair of telephone wires (the other of which is called the ring).

X2.3.1.462 **tone**—an audio or carrier of controlled amplitude and frequency used in a selective signaling system, or for equipment control purposes.

X2.3.1.463 **tone code**—a specified character of transmitted tone signals required to effect a particular selection or function.

X2.3.1.464 **tone-coded squelch**—a system whereby a superimposed tone is transmitted with the radio carrier to protect against nuisance-type interference.

X2.3.1.465 **tone, Type 90**—General Electric's name for a system of single-tone signaling. The tones are generally between 1000 and 2400 Hz in two bands.

X2.3.1.466 **tone, Type 99**—General Electric's name for its two-tone sequential selective signaling system. Sometimes called Sel-Call. The tones are generally between 520 and 953 Hz.

X2.3.1.467 **topographic map**—an accurately scaled map having contour lines which show the elevation above sea level. Used in preparing profiles of radio propagation paths.

X2.3.1.468 **touch pad**—a method of signaling or encoding and decoding address codes by the use of a simple numerical push button keyboard.

X2.3.1.469 **Touchtone**—a Bell System trademark used to describe their method of signaling and use of dual tone multifrequency (DTMF) tones.

X2.3.1.470 **tower, antenna**—a tall antenna support structure used to support one or more antennas or when an antenna must be mounted high above the ground or other support formation such as a building.

X2.3.1.471 **traffic**—used for messages handling by a radio communications system.

X2.3.1.472 **transceiver** —the combination of radio transmitting and receiving equipment in a common housing, usually for portable or mobile use, and using common circuit components for both transmitting and receiving.

X2.3.1.473 **transformer**—an electrical device for voltage current transformation, or impedance matching, or both.

X2.3.1.474 **transfer method**—the PSAP interrogator determines the proper responding agency and connects the user to that agency. To perform the necessary dispatching in accordance with prearranged plans with cooperating agencies.

X2.3.1.475 **transient**—a rapid, sometimes violent, fluctuation of voltage or current in a circuit usually of short duration caused by switching or changes in load.

X2.3.1.476 **transmitter**—apparatus for the production and modulation of radio frequency energy for the purpose of radio communication.

X2.3.1.477 **transmission line**—a waveguide, coaxial line, or other system of conductors used to transfer signal energy efficiently from one location to another. In communications systems, the coaxial line between the base station and the antenna.

X2.3.1.478 **trunk**—a circuit used for connecting a subscriber in a central office to all other services in/out of the switching equipment.

X2.3.1.479 **trunk line**—a telephone line that terminates at a switchboard rather than a telephone.

X2.3.1.480 **TSPS**—an electronic operating position system whereby operator-handled traffic is routed to its final destination via a central switching machine.

X2.3.1.481 **turret**—a section of a communications control console, containing switches, controls, meters, and so forth.

X2.3.1.482 **two-way radio**—a radio that is able to transmit and to receive.

X2.3.1.483 **two-wire operation**—uses a single pair (two wires) for both transmitting and receiving.

**U**

X2.3.1.484 **Ultra High Frequency (UHF)**—frequencies between 300 and 3000 MHz.

X2.3.1.485 **ultrasonic**—describing frequencies higher than those which are audible. Generally above 20 000 Hz.

X2.3.1.486 **unbalanced line**—a transmission line in which the voltages on the two conductors are unequal.

X2.3.1.487 **Underwriters Laboratories, Inc**—a laboratory sponsored by the National Board of Fire Underwriters that examines and tests devices, material, and equipment whose action may affect casualty, fire, and life hazards.

X2.3.1.488 **unmodulated**—without modulation; the RF carrier signal alone as it exists during pauses in conversations.

X2.3.1.489 **upper sideband**—the higher of two frequencies or groups of frequencies produced by a modulation process.

X2.3.1.490 **utility**—a power, gas, or water service available to the public.

**V**

X2.3.1.491 **Van Allen belts**—radiation belts that surround the earth, consisting of electrons and protons at high energy levels.

X2.3.1.492 **varactor**—a semiconductor diode used as a variable capacitor. Used as a harmonic generator, frequency multiplier, and amplifier.

X2.3.1.493 **vehicular repeater station**—a mobile station in the mobile services authorized to retransmit automatically on a mobile service frequency, communications originated by hand-carried portable units or by other mobile or base stations directed to such hand-carried units.

X2.3.1.494 **Versatone** —General Electric company tradename for a solid state tuned tone determining element.

X2.3.1.495 **vertical antenna**—a vertical steel tower, rod, or shaft used as an antenna.

X2.3.1.496 **Very High Frequency (VHF)**—frequencies between 30 and 300 MHz.

X2.3.1.497 **Vibrasponder**—Motorola Communications company tradename for a tone determining vibrating reed element.

X2.3.1.498 **voice grade**—a communications circuit that is nominally 300 to 3000 Hz.

X2.3.1.499 **voltage standing wave ratio (VSWR)**—the ratio of the maximum voltage to the minimum voltage along a transmission line. It is the measure of the mismatch between the load and the line.

X2.3.1.500 **volume control**—a potentiometer voltage divider used to adjust the loudness of an audio circuit.

X2.3.1.501 **volume unit (VU)**—a measure of the magnitude of sound from an electrical wave. Measured in decibels.

X2.3.1.502 **voting**—automatic selection of remote radio receiver. All incoming signals are compared for signal strength and the first signal found that meets or exceeds a preset level is selected and sent to the audio amplifier.

**W**

X2.3.1.503 **watt**—the unit of power.

X2.3.1.504 **wattmeter**—a meter to indicate the rate at which electrical energy is being used or produced.

X2.3.1.505 **wave**—a propagated periodic disturbance such as a radio, light, or sound wave.

X2.3.1.506 **waveguide**—a transmission line comprising a hollow conducting tube within which electromagnetic waves may be propagated. Generally used in microwave communications systems.

X2.3.1.507 **wavelength**—the distance measured along the direction of propagation between two points that are in phase on adjacent waves. A wavelength is the distance traveled by a wave in the time of one cycle. Electromagnetic waves include both light and radio waves and travel in space at approximately 300 000 000 m/s. To determine the exact length of a wave, divide 300 000 000 m by the frequency in hertz.

X2.3.1.508 **wave, radio**—an electromagnetic wave that travels through space at the speed of light.

X2.3.1.509 **wave, refracted**—a radio wave that is bent (refracted) as it travels into a second medium of propagation, such as from the atmosphere to the ionized layers of the stratosphere.

X2.3.1.510 **weatherproof**—so constructed or protected that exposure to the weather elements will not prevent proper operation.

X2.3.1.511 **weathertight**—so constructed that exposure to a driven rain will not result in the entrance of water.

X2.3.1.512 **wire** —a single metallic conductor.

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