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# NFPA 297 Guide on Principles and Practices for Communications Systems 1995 Edition

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An International Standards-Making Organization

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### Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

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**NFPA 297**

**Guide on**

# Principles and Practices for Communications Systems

**1995 Edition**

This edition of NFPA 297, *Guide on Principles and Practices for Communications Systems*, was prepared by the Technical Committee on Public Fire Service Communications and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held May 22-25, 1995, in Denver, CO. It was issued by the Standards Council on July 21, 1995, with an effective date of August 11, 1995, and supersedes all previous editions.

This edition of NFPA 297 was approved as an American National Standard on August 11, 1995.

## Origin and Development of NFPA 297

The Guide on Telecommunications Systems was originally published by the NFPA in 1975. Its purpose was, and still is, to provide general information relating to communication requirements of agencies involved in wildfire suppression operations. The guide was revised by the Technical Committee on Forest and presented to the Association for adoption at the 1985 Fall Meeting as NFPA 297.

During the 1995 Annual Meeting revision cycle, the title of the document was changed to reflect that communication systems are used in many applications. Communication systems are an integral resource for proper incident management, span of control, accountability, and personnel safety.

Communication systems are changing daily. Today, the ability to track personnel and apparatus is instantaneous. Geographic positioning systems (GPS), automatic vehicle locating systems (AVS), enhanced 911 (E-911), cellular phones, mobile data terminals, and computer-assisted dispatch have enhanced communication capabilities.

The technical committee members will continue to keep current with changing technology and terminology, and incorporate those changes into future editions. These changes will also be reflected in NFPA 1221.

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*This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.*

NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

**Committee Scope:** This Committee shall have primary responsibility for documents relating to the operation, installation and maintenance of public fire service communication systems.

## Contents

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# Principles and Practices for Communications Systems

## 1995 Edition

Information on referenced publications can be found in Chapter 6 and Appendix D.

## Chapter 1 Introduction

### 1-1 Scope.

**1-1.1** This guide deals with systems and their components and operations that involve the transfer of information over a distance utilizing electrical or electronic means. It is intended to provide general information only. More specific technical data should be secured from manufacturers or communication specialists in state, provincial, or local governments.

### 1-2 Purpose.

**1-2.1** The need for reliable communications has long been recognized in the fire service. This guide focuses on four basic elements in the communications requirements of a fire department. Included are communications between the public and the fire department; communications within the fire department under emergency and nonemergency conditions; communications among fire departments; and communications between the fire departments and other agencies.

### 1-3 General.

**1-3.1** Radio, telephone, and other electronic equipment, operating procedures, and personnel training should enable messages to be conveyed as quickly and reliably as the situation requires. Messages should be sent and received correctly with no delay. Effective operating practices should be developed and training should be provided to meet the needs of each department. The measure of adequate service is the ability of the system to handle both emergency situations and the normal daily activities of the department.

**1-4 History.** In early America, fire companies were brought together by the ringing of bells and gongs, shouting, and word of mouth. In contemporary America, municipal fire department companies are equipped with direct line or radio signaling systems, while suburban or rural companies may alert volunteers with a loud, audible signal produced by siren or horn, or by radios or paging systems at their homes or businesses.

The need for reliable communications has long been recognized in the fire service and is exemplified by the crossed trumpets insignia on the chief officer's badge. The use of the trumpet as a megaphone by chief officers was one of the earliest methods of extending communications beyond the normal range of the human voice. The fire bell in the steeple was an early form of communication used to notify volunteers of the existence of a fire. Hand signals had their beginning in the early days of the fire service and are still used successfully today. With the inventions of telephone, radio, and computers, the field of fire communications took giant leaps forward.

**1-5 Definitions.** Unless expressly stated elsewhere, the following terms will, for the purpose of this guide, have the meanings indicated below.

**Acknowledgment.** The act by which one operator signifies to another that a message has been received.

**Added Information Message.** A message sent to supplement a previous message and referred thereto.

**Air Net.** A radio communications network designed to provide air-to-air and air-to-ground communications for agency-owned or contract aircraft. Air nets are often designed on a regional basis.

**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. The magnitude of the radio wave is varied in accordance with the information to be transmitted or exchanged.

**Antenna.** A system of wires or electrical conductors employed 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. (Also known as aerial.) Also, a device used on a vehicle and at a station to radiate the transmitted signal and to receive a signal.

**Approved.** Acceptable to the authority having jurisdiction.

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**Attenuation.** The decrease in amplitude of a signal during its transmission from one point to another. It can be expressed as a ratio or, by extension of the term, in decibels.

**Audio.** The voice component of the transmitted signal. The normal ear responds to audio frequencies.

**Authority Having Jurisdiction.** The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or

others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

**Band.** A range of frequencies between two definite limits. By international agreement, the radio spectrum is divided into nine bands. Also, a term applied to a group of frequencies.

**Bandwidth.** The width of a band of frequencies used for a particular purpose. Also, 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 three decibels below the average level. Half power points are also used as limits.

**Base.** Short for "base station."

**Base Station.** A land station in the land mobile service carrying on a service with land mobile stations. Also, the two-way radio transmitting location.

**Battery Drain.** The amount of electrical power taken from the battery through use of the two-way radio equipment. Usually measured in amps.

**Broadcast.** Radio or television transmission intended for general reception.

**Broadcasts.**

(a) *Broadcast.* The transmission of a message to the coded area concerned.

(b) *Direct Message.* A message addressed to a specific point or points on a system.

(c) *All Points Bulletin (APB).* A message direction indicating that the message is to be sent to all points.

**Cable.** One or more insulated or noninsulated wires used to conduct electrical current or impulses. Grouped insulated wires are called a multi-conductor cable.

**Cancellation.** A message that cancels another, without delay.

**Capture Ratio.** The ability of an FM radio receiver to reject unwanted signals and interference on the same frequency as a desired signal, measured in decibels. The lower the figure, the better the receiver performance.

**Carrier.** Radio wave radiated without modulation by a transmitter. Also, an electromagnetic wave at a specific frequency.

**Carrier Frequency.** The frequency of an unmodulated electromagnetic wave.

**Channel.** Sometimes used synonymously with "frequency." It is the electronic signal path through which radio frequency flows.

**Channel Bandwidth.** The difference between the upper and lower frequency limits of a channel, expressed in hertz.

**Channel, Point-to-Point.** A radio channel used for radio communication between two definite, fixed stations.

**Channel, Radio.** An assigned frequency 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.

**Chassis.** The part of the two-way radio that contains the transmitter and receiver assemblies.

**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. (Also called a coaxial line or concentric line.)

**Co-Channel Interference.** Interference caused by other parties using the same transmitting frequency already being used.

**Communication Center.** A building or portion of a building specifically configured for the primary purpose of providing emergency communication services to one or more public safety agencies under the authority(ies) having jurisdiction. This facility should apply to all areas necessary for operation, domicile, and the installation of necessary equipment.

**Communications Channel.** Similar to a radio frequency, but more general. It is a medium over which communications are established and carried out.

**Communications Link.** Established communications between two parties.

**Communications Network.** A combination of links that are complete as to some specific function (e.g., a network to serve command personnel; a network to serve air-to-air control).

**Communications System.** A combination of links or networks that serve a general function (e.g., a ground attack communications system made up of command, tactical, service, and intracamp networks).

**Continuous Duty.** A rating applied to receivers and transmitters to indicate their capability for use in a continuous duty cycle (as opposed to the term "intermittent duty").

**Control Console.** A panel that contains controls to operate communications equipment.

**Couple.** To connect two circuits so that signals are transferred from one to the other.

**Crystal.** A device that controls the exact operating frequency of the transmitter or receiver.

**Crystal Controlled.** Radios in which each operating frequency is determined and controlled by a vibrating quartz crystal. This limits the number of channels available because of the physical size of the crystals required.

**Crystal-Controlled Oscillator.** An oscillator in which the frequency of oscillation is controlled by a piezoelectric crystal.

**Crystal-Controlled Transmitter or Receiver.** A radio transmitter or receiver in which the carrier frequency is controlled directly by a crystal oscillator.

**Directional Antenna.** An antenna possessing the ability to strongly radiate signals in a specific direction.

**Directivity.** The value of the directive gain of an antenna in the direction of its maximum value. The higher the directivity value, the narrower the beam in which the radiated energy is concentrated.

**Dispatcher.** Common name applied to the station operator who relays message traffic in the system. (*See Operator.*)

**Distortion.** Unfaithful reproduction of audio or video signals due to changes occurring in the waveform of the original signal somewhere in the course it takes through the transmitting and receiving system. Classified as linear, frequency, and phase distortion.

**Duplex Channel.** A communications channel providing simultaneous transmission in both directions. (*For comparison, see Simplex Channel.*)

**Duplex Operation.** A method of operation in which communication between stations takes place in two directions simultaneously. A separate channel is necessary for each direction of transmission. (*For comparison, see Simplex Operation.*)

**Electromagnetic Energy.** The type of energy contained in any electromagnetic wave such as radio waves, visible light, x-rays, gamma rays, or cosmic rays. The frequencies of radio waves go up to about 300,000 MHz.

**Electromagnetic Radiation.** Radiation associated with a periodically varying electric and magnetic field that is traveling at the speed of light, including radio waves, light waves, x-rays, and gamma radiation.

**Energy, Radio Frequency.** See Electromagnetic Energy.

**Facsimile (Fax).** Facsimile is the process whereby images (either print or picture) are translated into an electric signal, transmitted over a communications link, and reconstituted at the receiving end into the original image.

**Fade.** The variation of radio field strength caused by a gradual change in the transmission medium.

**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.

**Fire Department.** An organization providing rescue, fire suppression, and related activities. The term "fire department" shall include any public, governmental, private, industrial, or military organization engaging in this type of activity.

**Frequency.** The number of cycles per second; the reciprocal of the period. Usually refers to the assigned channel. Literally means the time taken by a signal to complete one cycle.

**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.

**Frequency Modulated (FM).** The frequency of the radio wave is varied in accordance with the information to be transmitted or exchanged.

**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.

**Frequency Stability.** The ability of the transmitter to keep the transmitted signal within predetermined limits. (All signals radiate energy outside of their intended paths.)

**Generator.** A device that develops either direct or alternating electrical voltage at any frequency.

**Global Positioning System (GPS).** A precise radio positioning system utilizing satellites.

**Guard Band.** A narrow band of frequencies provided between adjacent channels in certain portions of the radio spectrum to prevent interference between stations.

**Half-Duplex Channel.** A communications channel providing duplex operation at one end of the channel, but not the other. Typically, the base station is operated in the duplex mode. (*For comparison, see Simplex Channel and Duplex Channel.*)

**Handset.** A telephone-type combination microphone/speaker that allows privacy of sending and receiving messages.

**Hertz (Hz).** A unit of frequency expressed in cycles per second. One Hz equals one cycle per second.

**High Band VHF.** Radio frequencies from 132 MHz to 174 MHz.

**Incident Management System.** An organized system of roles, responsibilities, and standard operating procedures used to manage emergency operations. Such systems are often referred to as Incident Command Systems (ICS).

**Interference.** See Radio Interference.

**Jurisdiction.** Any government unit, such as a federal agency, state, county, city, town, or fire-protection district.

**Keying.** Activating the transmitter. When the push-to-talk button is pressed, the transmitter is keyed.

**Labeled.** Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**Link.** A transmitter-receiver system and transmission medium forming a two-way path for the transmission of information.

**Listed.** Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the

equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

**Local Control.** Term applied to a locally (rather than remotely) operated station.

**Low Band VHF.** Radio frequencies from 30 MHz to 50 MHz.

**Megahertz (MHz).** A common technical term that refers to the frequency of the radio. One MHz equals 1,000,000 cycles, or hertz, per second.

**Microwave.** A term applied to radio waves in the frequency range of 890 MHz and above.

**Mobile Unit.** A two-way radio-equipped vehicle or person. Also, sometimes the two-way radio itself, when associated with a vehicle or person.

**Modulation.** The process of modifying some characteristic of an electromagnetic wave (called a carrier) so that it varies in step with the instantaneous value of another wave (called a modulating wave or signal). The carrier can be a direct current, an alternating current (provided its frequency is above the highest frequency component in the modulating wave), or a series of regularly repeating, uniform pulses called a pulse chain (provided their repetition rate is at least twice that of the highest frequency to be transmitted). Also, the strength of a voice applied to the microphone.

**Monitor.** To listen to radio messages without transmitting.

**Multi-Channel System.** A radio system that uses more than one radio channel. Also known as multi-frequency system.

**Multiplexer.** A device that simultaneously transmits two or more signals over a common carrier wave.

**Noise.** Interference characterized by undesirable random voltages caused by an internal circuit defect or by some external source.

**Noise Cancelling.** This term is applied to microphones that blank out bothersome background noises and permit communication in high-noise areas.

**Omni-Directional Antenna.** An antenna that radiates signals with equal strength in all directions.

**Operator.** A person or persons certified to receive or retransmit an alarm in the communication center.

**Output.** The energy resulting from the work the radio performs. Power output is the strength of the signal as it leaves the transmitter. Audio output is the strength of the voice wave as it leaves the speaker. Both are usually measured in watts.

**Pager.** A compact radio receiver used for providing one-way communications.

**Portable Radio.** A completely self-contained radio that can be moved from one position to another.

**Power Source.** The power obtained from the utility distribution system, an engine-driven generator, or a battery.

**Power Supply.** A device that receives its input power from a power source and converts the input power to the alternating current or direct current voltage(s) required to operate the system.

**Propagation Characteristics.** Descriptions of how effectively a radio wave is transmitted from one place to another.

**Propagation (Electromagnetic).** The travel of electromagnetic waves through a medium.

**Public Safety Answering Points (PSAP).** An identified location for the receipt and routing of emergency calls.

**Radio-Frequency Power.** The power associated with any signal consisting of electromagnetic radiation that is used for communications.

**Radio Interference.** Undesired disturbance of radio reception.

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

**Radio Receiver.** An instrument that amplifies radio-frequency (RF) signals, separates the intelligence signal from the RF carrier, amplifies the intelligence signal in most cases, then converts the intelligence signal back into its original form.

**Radio Station.** A fixed or mobile installation that is equipped to transmit and receive radio signals.

**Radio Transmitter.** A radio-frequency power source that generates radio waves for transmission through space.

**Relay Station.** See Repeater Station.

**Repeater Channel.** A two-frequency channel that utilizes an intermediate repeater to extend the range of the channel. The repeater unit simultaneously receives on one frequency and transmits on another.

**Repeater Station.** An operational station established for the automatic retransmission of communications.

**Selective Call.** A system for communicating individually with selected vehicles, stations, or personnel.

**Sensitivity (of a Radio Receiver).** The minimum input signal needed by a radio receiver to produce a specified output.

**Shadow Area.** A dead spot in a communicating area where radio communication is difficult or impossible.

**Should.** Indicates a recommendation or that which is advised but not required.

**Side Band.** A frequency band above and below the carrier frequency, produced as a result of modulation.

**Simplex Channel.** A communications channel providing transmission in one direction only at any given time. (*For comparison, see Duplex Channel.*)

**Simplex Operation.** A method of operation in which communication between two stations takes place in only one direction at a time. (*For comparison, see Duplex Operation.*)

**Single-Frequency Channel.** A channel that is direct from transmitter to receiver. Transmitter and receiver frequencies are identical.

**Spectrum.** Any series of radiant energies arranged in order of frequency.

**Squelch.** A system for removing objectionable background noise by desensitizing the receiver.

**Station Identifier.** The radio call sign assigned by the Federal Communications Commission.

**Telephone Patch.** An instrument that allows a radio to be used as an entrance and exit point from the commercial telephone system.

**Text.** The body of a message.

**Traffic.** A message, or communication, between stations.

**Transceiver.** Combined transmitter and receiver unit.

**Transmission Line.** A communication medium used to transfer energy from one location to another.

**Trunk Line.** A telephone line or channel between telephone central officers or switching devices, including lines to the fire alarm telephone switchboard.

**Two-Way Radio.** A radio that is able to both transmit and receive.

**Ultra High Frequency (UHF).** Radio frequencies from 300 MHz to 3000 MHz.

**Unit Identifier.** An identifier assigned by the licensee to a mobile unit for exact identification.

**Very High Frequency (VHF).** Radio frequencies from 30 MHz to 300 MHz.

## Chapter 2 Basic Concepts

**2-1 System Elements.** There are four basic elements in the communications requirements of a fire-protection agency. Each plays an essential part in enabling the fire department to meet its protection responsibility. The particular method used should provide for each element in order to be effective. (*See Figure 2-1.*)

Radio, telephone, and other electronic equipment, operating procedures, and personnel training should enable messages to be conveyed as quickly and reliably as the situation requires. Messages should be sent and received correctly with no delay. Time delay and the number of messages to be handled are strongly interrelated with service. Systems and equipment should be provided so that the public can notify the fire department of fires or other emergencies. Attention should be given to message types, the number and length of messages, the equipment capabilities, radio frequencies, and system organization. Effective operating practices should be developed and training should be provided to meet the needs of each agency. The measure of adequate service is the ability of the system to handle emergency situations as well as the normal daily activities of the agency. A major conflagration, or multiple fires, generates a much greater need for communications than do normal daily activities.

**2-1.1 Communications Between the Public and the Fire Agency.** Communications between the public and the fire department revolve around several areas:

(a) Calls from the public for emergency assistance or for reporting fires;

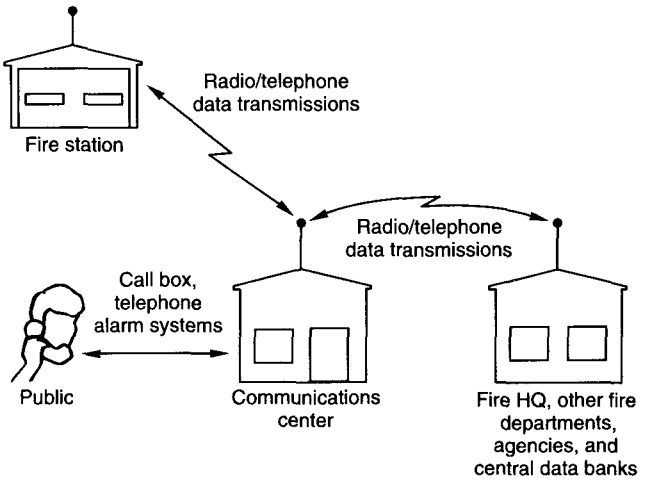


**Figure 2-1 Fire communications.**

(b) Calls from the public giving information to, or requesting information from, the fire department; and

(c) Calls from the fire department to the public.

Calls from the public, usually received through the telephone system, giving or requesting information, can be of an emergency nature. Whether or not such a call is an emergency is decided by the individual answering the telephone. Many fire departments maintain different administrative and emergency telephone numbers to keep the two types of communications separate. Calls from the fire department to the public usually are of an administrative nature. 9-1-1 (universal emergency number) reporting has become common. (*See Figure 2-1.1.*)

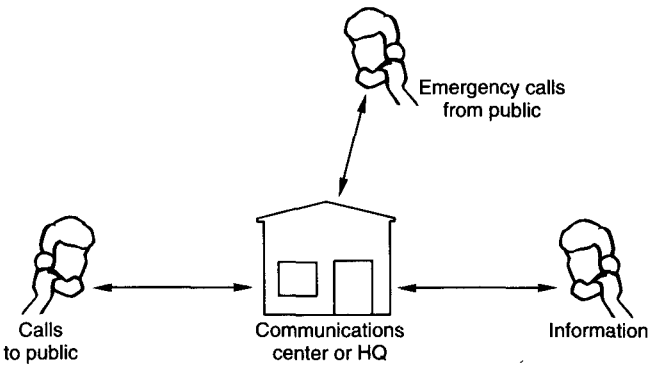


**Figure 2-1.1 Typical fire department communications with the public.**

**2-1.2 Communications within the Fire Department.** Communications between members of the fire department include emergency and nonemergency messages. Communications can be accomplished by radio, telephone, or other transmission methods and might involve the dispatcher, radio-equipped vehicles (land, water, or air), personnel equipped with two-way radios, or personnel at outlying stations in a variety of situations. (*See Figure 2-1.2.*) Examples of such communications are as follows:

(a) The dispatcher gives information to the fire stations and mobile equipment.

(b) Personnel report location and work status to the dispatcher for emergency assignment.

(c) The dispatcher gives coordination information and status to personnel and equipment responding to an emergency.

(d) Incident commanders give instructions to personnel under their command.

(e) Tactical communications at a fire or other emergency scene.

(f) The information on status of personnel and equipment, fire danger rating, weather forecasts, and outdoor burning.

**2-1.3 Communications Among Fire Departments.** Many fire departments supply neighboring departments with requested information. Such communications are necessary because many small agencies depend on mutual aid agreements. In addition, many fire departments have common information needs.

Incidental or nondirected communication among agencies occurs whenever one agency monitors the transmissions of another, although the information is not specifically intended for interagency distribution. Most of this kind of communication is by radio, especially among agencies that share a radio channel. (When agencies have a choice of channels on which to operate, they must weigh the advantages of mutual monitoring by all system users against the disadvantages of greater message traffic and the resulting problems of channel loading.) This kind of communication is no less important than directed communication, for it allows one agency to be aware of situations in another community or area that may spill over or involve it directly in a short time.

Monitoring of nearby fire departments or fire department transmissions helps the listener to anticipate the need for mutual aid and to be aware of the level of emergency activity in an area larger than the department's or agency's own boundaries. If two fire departments anticipate a need for mutual aid or cooperation, they frequently monitor each other's calls even when not on the same radio channel. Monitor receivers at the dispatcher positions are generally used.

Special mutual aid radio frequencies or channels for mobile use only have been licensed so that fire departments from adjacent jurisdictions can communicate directly with each other. Such a channel can assist normal day-to-day interagency communication needs and emergency communication during widespread disasters. The channels can serve as command channels for interagency communication. Although these are helpful, there are also problems with them. The frequencies can become overloaded very quickly. The multi-channel mobile radio allows all radio traffic to be conducted on the "Agency in Charge" radio system, from initial attack through large fire operations. (*See Figure 2-1.3.*)

**2-1.4 Communications Between the Fire Department and Other Agencies.** Another function of a communications system is to pass messages between the fire department and public safety oriented agencies, such as public works, highway maintenance departments and utilities, hospitals and ambulance services, towing and wrecker services, law enforcement agencies, civil defense units, industries, media, and weather forecasters.

Fire departments exchange a large variety of information with nonfire agencies. Since many of these agencies are radio equipped, they can be of assistance during large fires or other major incidents.

One of the greatest demands for communications with other agencies can occur during major emergencies. The ability to meet this problem necessitates planning for message volumes and for possible language barriers. Communications for a fire department or fire agency should include contingency plans for emergency situations. During an emergency there is little time to set up new communications links. The volume of messages to be handled is likely to exceed most estimates, so plans should include means for handling the volume of message traffic to prevent system breakdown due to overloading. Concerned public and media can rapidly overload a telephone system. Nonfire agencies might not understand the standard language of fire radio. Therefore, liaison personnel familiar with the radio language of the fire service and the assisting organizations are needed to maintain effective communications. Any incident management system should include two important communications concepts, that should improve communications effectiveness during major emergencies. These are:

(a) Common terminology — using clear text or plain language and established standard terms and phrases, and

(b) Integrated incident communications — intending the best possible use of all participating agency radio systems including frequency-sharing agreements. (*See Figure 2-1.4.*)

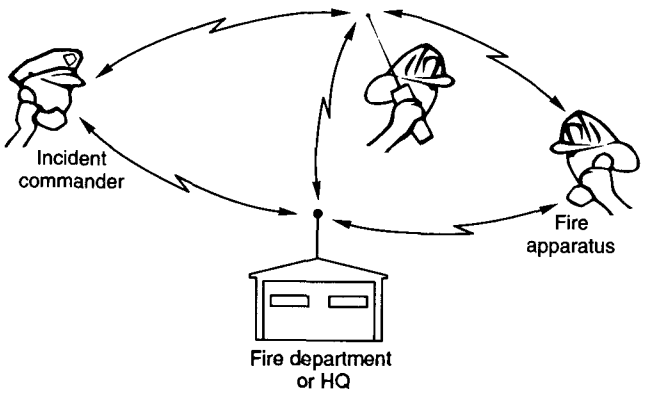


**Figure 2-1.2 Fire department radio communications.**

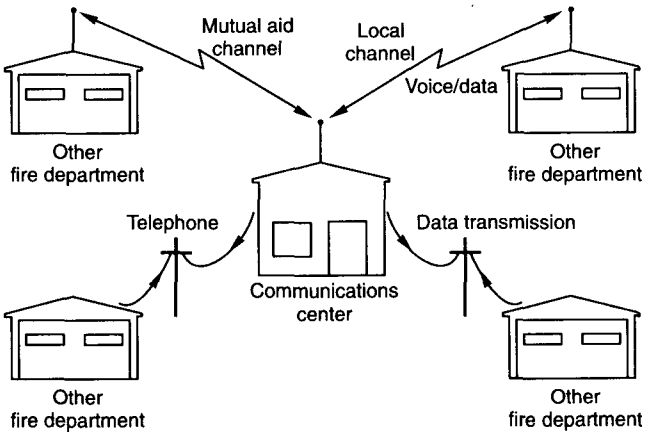


**Figure 2-1.3 Interdepartmental communications.**

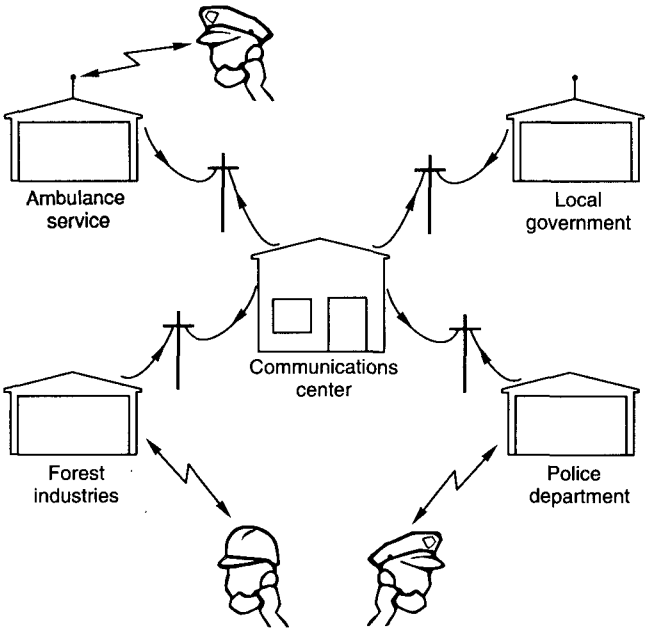


Figure 2-1.4 Communications with other agencies.

**2-2 Communications Systems.** Many types of equipment comprise a fire communications system. First, the basic element is the public telephone network. Next is the communications center radio equipment. It consists of transmitters capable of sending messages to every point in the area. Often a control console is used to coordinate communications such as transmitter and receiver control, telephone, computer, and other functions. Antenna systems complete the base station segment of the system. New technology allows use of remote repeaters with self-contained power systems, such as solar power. Portable mobile relays can be used during large fires or remote emergencies. Mobile units complete the system and include two-way radios in administrative vehicles, fire apparatus, aircraft and other transportation, radios carried by individuals, mobile command posts, pocket pagers, and similar units.

**2-2.1** There are also data transmission systems, which permit exchange of maps, data, and other information within the department or with other agencies. Low-cost computer systems can provide users with a broad array of intra- and interagency capabilities.

Electronic mail service utilizing computers is often less costly and more efficient for the transmission of messages than conventional mail or voice telephone systems. A wide range of options can be used to tailor electronic mail service to specialized needs.

A computer, modem, communications software, and telephone might be necessary to use electronic mail service.

An originator can send documents or messages directly to a recipient, utilizing a compatible electronic messaging service for immediate reading — or, if more convenient, for storage until it can be read. An electronic mailbox is an option whereby an originator stores a message in a central computer until it is electronically collected by the recipient at a convenient time.

**2-2.2 The Telephone System.** The public should be able to contact a fire department quickly when in need of assistance. The telephone system is a natural means of public — fire department contact. It is usually available, and most people know how to use it even under stress conditions. (Use might increase as the national emergency number 9-1-1 is adopted in additional areas of the country.) In addition, the telephone system gives a backup means of communication in case of radio failure, and a means of passing lengthy information not appropriate for radio transmission. In some areas, a system of emergency call boxes is used for reporting fire and is available to the public and the fire department. This provides an alternate means of communication that can augment the radio system.

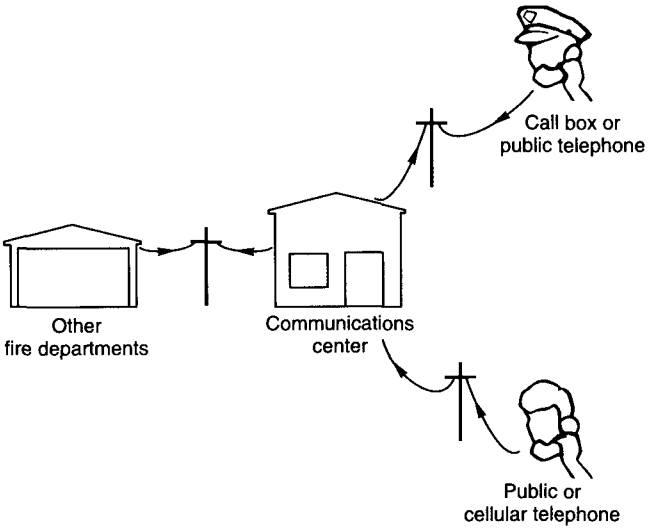


Figure 2-2.2 The telephone system.

The telephone system is also relied upon to exchange urgent information between fire departments or other agencies by special hot lines that connect agencies. (*See Figure 2-2.2.*)

**2-2.3 The Radio System.** Radio communication is used by most fire departments as their primary means of communications. Its mobility makes it uniquely suited for fire service use. Radio keeps fire-fighting units in touch with the communications center and facilitates reporting on emergency situations by requesting additional assistance and informing other units of emergencies. Radio is also used on special duty work, such as fire prevention, fire hazard inspections, or other projects. Thus, it promotes efficient use of equipment and personnel.

Large, or multiple, incidents necessitate that incident commanders be able to direct their forces continually. Control of sizable forces of personnel and equipment might be needed. Command level personnel cannot make intelligent decisions about deployment unless they obtain constantly updated information on the situation; contact with radio-equipped members of those forces provides the information so it can be acted on at command level. (*See Figure 2-2.3.*)

**2-3 Basic System Capabilities.** Communications systems should convey all messages for effective response, protection, and service. The ability to convey messages means that:

(a) There are no excessive delays in sending messages.
(b) Length and content of messages are appropriate.

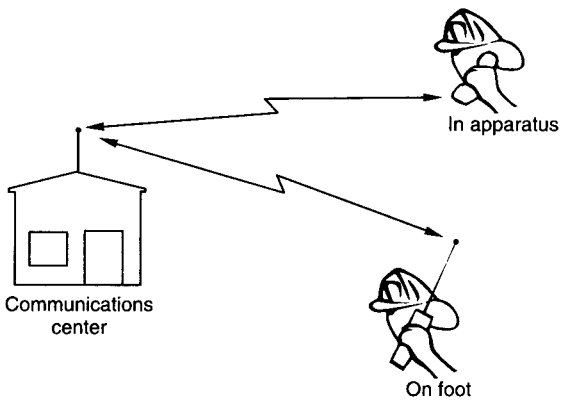


**Figure 2-2.3 The radio system.**

(c) Information is not degraded by interference on the radio system.

(d) The means of transmitting messages is determined by their emergency nature, privacy needs, and length.

**2-3.1** Communications systems should be designed with the goal of minimizing the average waiting time during busy periods. The number of people wishing to use the system will vary in emergency situations, but waiting time increases during periods of heavy message traffic when the urgency of messages might be great.

**2-3.2** The second element for an effective system concerns controlling the length and content of messages sent over the system. These should be adequate to convey necessary information, but average length of messages and conversations allowed on a system at a given time determines the average waiting time for any user of the system.

**2-3.3** The third element is that messages should not be degraded by interference. Radio interference can consist of:

(a) Signals generated by electrical devices, such as auto ignition, electric motors, and neon signs;

(b) Other radio stations using the same or adjacent frequencies;

(c) Background noise picked up by the user's microphone; or

(d) Faulty radio equipment.

**2-3.4** The fourth general element is that the system should provide an alternative means of communication to the primary network. Many messages are not urgent and do not require the speed the primary system provides, or they might be lengthy, using excessive transmission time. The telephone offers one alternative and provides a means of communicating with other fire departments and public service agencies.

**2-4 System Demands.** The fluctuation in message traffic over hourly, daily, weekly, monthly, and yearly periods can be a factor in determining system demands. The quantity of messages can change from minute to minute due to factors such as:

(a) Chance occurrence of events needing fire services;

(b) Daily and weekly patterns of human activity;

(c) Changes in patterns due to seasonal and weather conditions;

(d) Special events that necessitate fire services; and

(e) Catastrophes and emergency situations with related events needing fire services.

It is imperative that a fire communications system be reliable and flexible and always available for use. Reliability depends on equipment and method of operation, and can be increased with good quality equipment and competent preventive maintenance with backup capability. Because fire department communications systems perform a variety of functions, they should be flexible to fulfill these functions. They also include the ability to circumvent equipment failures to get messages through and meet the greater demands that future growth might put on the system.

**2-4.1** Since communications systems must provide emergency service, reliability requirements for equipment are much higher than for less critical services. Equipment must handle normal peak loads with almost the same rapid response as during times when message loads are minimal. This necessitates that equipment and personnel capacities be geared to handle peak loads rather than average loads.

**2-4.2** For maximum reliability, a communications center should not depend upon commercial power as the only source of electrical power supply. A continuing source of electrical power with a standby power plant should be provided. If a power blackout occurs, the standby generator automatically takes over as the power source. Selection of a generator should include consideration of the expected power load. The standby power should be capable of handling the essential load of the building but need not supply the entire electrical load, since it is unlikely that all equipment will be in use at one time. In addition, installation of battery-operated equipment at key locations such as the communications center and relay stations ensures a more fail-safe condition, however the standby generator is still needed.

## Chapter 3 Telephone Communications

**3-1 Telephone Service Requirements.** Fire agencies require four types of telephone service:

(a) incoming emergency calls,

(b) incoming administrative calls,

(c) outgoing emergency calls, and

(d) administrative calls.

The telephone portion of the system can vary widely depending upon the size of the fire department and the workload. The system might sound a warning alert, summoning volunteers, or might be monitored by an answering service, by a local law enforcement agency, or by a central dispatch service.

**3-1.1** A fire department should lease enough lines on the emergency number for all calls, and it should establish a separate group of lines on a second number for callers who do not want emergency service. Different types of lines are available and are used by the fire department. Information on these services is available from local telephone companies. Communications centers need at least one outgoing only line so they can always make an outgoing call when all other lines are busy. All lines should be the type whereby the outside calling party cannot hold the line if the called party hangs up.

**3-1.2** It is important that the phone system be capable of operation during a power failure.

**3-1.3** A specific telephone number should be assigned for fire alarm emergency service and a separate number assigned for normal fire department business. Telephone directory listings should be as follows:

(a) On the inside front cover of the white pages directory:

**FIRE** (Symbol optional) (fire number)

In the white pages directory:

**FIRE DEPARTMENT**

To report a fire (fire number)

Nonfire purposes (business number)

(b) The fire department listing should also appear in the directory under the name of the municipality.

(c) If the directory covers an area that is protected by more than one fire department or fire protection district, each such department or district should be listed as outlined above.

(d) Telephones installed in fire stations should not be listed in the telephone directory.

Where suitable arrangements have been made for the receipt and handling of all emergency calls for fire, police, ambulance, etc., at a single communication center, such as through the use of the national emergency number 9-1-1, the directory listing should be appropriate.

**3-1.4** Telephone system backup should be provided. The backup for important leased circuits can be obtained by the use of parallel lines.

## Chapter 4 Radio Communications

**4-1 The Radio Spectrum.** The fire department radio systems operate on assigned frequencies. When radio frequencies are taken as a group, the term "radio-frequency spectrum" is used. This is a means by which energy can be transmitted at one point and received at another and, in the process, convey information. Every transmission has three basic attributes:

(a) It occupies a certain geographic area,

(b) It occupies a certain period of time, and

(c) It occupies a certain portion of the radio spectrum. (*See Figure 4-1.*)

These are very important to remember. A basic rule is that no two radio users can use the same portion of the spectrum at the same time in the same area without interfering with each other. In order to prevent interference, users should be separated adequately in frequency, area of operation, or time.

**4-1.1** The radio spectrum can be compared to the light spectrum; just as a rainbow has colors easily separated from each other, so does the radio spectrum have frequencies with unique characteristics. Groups of frequencies have been assigned for specific uses, such as broadcast radio, television, radio communications for vehicles, and radio voice and data communications. These have been assigned for land mobile service: 30 MHz – 50 MHz (VHF low band)

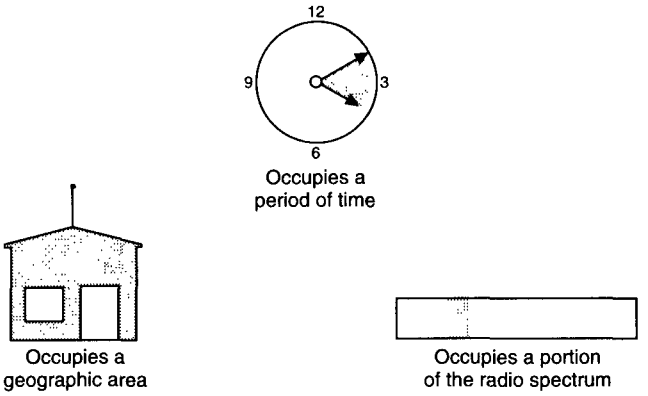


**Figure 4-1 Basic attributes of a radio transmission.**

132 MHz – 174 MHz (VHF high band), and 450 MHz – 512 MHz (UHF ultra high band). In addition, the 220 MHz – 222 MHz and 802 MHz – 869 MHz band is now available.

Each of these bands has unique characteristics. Presuming the transmit power is the same and no repeaters or automatic relays are used, the VHF low band provides the longest signal range of the three bands and is ideal for open country operation but can be seriously affected by sunspots or other long-range interference. The VHF high band provides shorter range than low band, but is less susceptible to radio interference, and ideal for combination city – country coverage. The UHF band provides the shortest range of the three bands. It is least affected by interference and seems to provide the best communications in congested city areas with tall structures.

**4-1.2** Certain radio frequencies have been made available for use by fire departments around the country. Each band consists of a group of frequencies, with center frequencies 15 KHz apart in the VHF high band and 25 KHz apart in the UHF band. In order to transmit information, a certain amount of the frequency spectrum is needed. This portion of the spectrum is termed the bandwidth of the transmission. Each user is assigned a certain amount of spectrum space, including a small amount of buffer called the guard band, which serves to prevent interference from adjacent channels. Radio transmission equipment should generate a precise signal on one channel or frequency, and the receiving equipment should select this signal without being disturbed by signals on nearby channels. Just as a highway or a river can be narrow or wide, so can a radio channel. The narrower the channels, the more channels that can be placed into a given section of the radio spectrum.

**4-1.3** Channels on the VHF high band and UHF bands have desirable propagation characteristics. If used properly, they provide the most efficient coverage of an area by reaching into all locations, but they are less likely to provide coverage over long distances. Because of their desirability and the relatively small area of spectrum available in each, the VHF high band and UHF bands have become crowded. Interference exists in some areas due to violation (often unavoidable) of the basic rule that radio transmission must be separated by time, geographical area, or frequency.

**4-2 FCC Rules and Regulations.** Frequencies, their assignment, and the widths of channels are regulated throughout the world. In the United States, the Federal

Communications Commission (FCC) provides this regulation through allocation, licensing, and rule making for all except federal government allocations. [In Canada, the similar regulating agency is the Department of Communications (DOC).] The Office of Communications Policy helps develop national spectrum utilization policy. The Interdepartmental Radio Advisory Committee (IRAC), under the Office of Communications Policy, performs functions similar to the FCC, but only for federal agencies. Wire line and radio communications are subject to FCC rules and regulations, which govern many areas of radio usage (called "service"). Of primary concern to fire communications systems users are the Public Safety Radio Services, which provide for use of radio communication systems by nonfederal governmental entities.

The needs of fire communications fall primarily within this category of regulations. The FCC apportions frequencies between commercial broadcast uses and nonbroadcast services, such as fire service radio. The Commission's prime resource, the radio spectrum, is not available without prior restrictions, since the federal government claims large portions of spectrum space for military and other operational use. Competition for frequencies is intense between users. The fire radio service and the forestry conservation radio service are only two parts of the land mobile group.

**4-2.1** The FCC has established requirements and specifications for radio equipment characteristics in order to reduce or eliminate harmful interference and to conserve the use of the radio-frequency spectrum. During discussions with radio equipment manufacturers, the system planner should have knowledge of the regulations that deal with frequency stability, type of emission, power level, and acceptable equipment. The provisions are in Part 90, Subpart B of the FCC Rules and Regulations. In the interest of reducing interference, the FCC has established certain rules basic to any station operation. Supervisors should make sure these rules are being observed constantly. Violations could result in suspension of their radio license.

**4-2.2** The basic FCC rules and regulations are as follows:

(a) All communications, regardless of nature, are restricted to minimum practical transmission time (excepting microwave systems).

(b) Continuous radiation of an unmodulated carrier (excepting microwave systems) is prohibited except when necessary for test purposes.

(c) Licensees are to take reasonable precautions to prevent unnecessary interference. If harmful interference does result, the FCC may require any or all stations to monitor the transmitting frequency before transmission.

(d) Tests may be conducted by any licensed station as required for proper station and system maintenance, but such tests are to be kept to the minimum. Precautions are to be taken to avoid interference with other stations.

(e) Maintain the required radio station records.

(f) The frequency and modulation must be measured and recorded when the transmitter is initially installed and when any change is made in the transmitter that might affect the frequency or modulation.

It is advisable to have frequency, power output, and modulation measurements made to ensure that the equipment operates within the parameters stipulated by the FCC.

(g) Posting of the radio license is required.

(h) Identify radio station when transmitting.

(i) Do not reassign or transfer a radio station license without the approval of the FCC.

**4-3 Frequency Coordination and FCC License Application.** Frequency assignment in the land mobile radio services is difficult because there are more users than can be readily accommodated in available spectrum space. This is particularly true for fire and police radio in and near metropolitan areas. The FCC, which issues licenses and allocates frequencies, has designated user groups in land mobile radio services to coordinate assignments in each service. The coordination committees include the International Municipal Signal Association (IMSA) for the fire, special emergency, and emergency medical radio services; the Associated Public Safety Communications Officials, Inc. (APCO) for the police and local government radio services, and all public safety users at 800 MHz; the Forestry Conservation Communication Association(FCCA) for the forestry conservation radio service; Forest Industrial Telecommunications (FIT) for the forest products radio service; and the American Association of State Highway and Transportation Officials (AASHTO) for the highway maintenance radio service.

**4-3.1** Frequency coordination is the process of selecting and recommending to an applicant and the FCC one or more radio frequencies for use by the applicant that will cause the least amount of interference to other radio users and to the applicant, and yet provide serviceable channels. This includes coordination of applications for new licenses and license modifications (involving power and antenna heights) with existing frequency assignments. Thus, the function of these frequency advisory committees is to minimize the likelihood of interference being caused to other systems by the operation of a proposed system. An application might require a committee to perform extensive research in determining physical separation, propagation paths, and the existence of other systems licensed on adjacent channels but in another service. If the application is favorably commented upon by a frequency advisory committee, the statement of the committee accompanies the application to the FCC, where it is processed.

**4-4 System Design Considerations.** A system (network) is defined as a number of radio stations in a certain geographical area, jointly administered or communicating with each other by sharing the same channel or channels. The size and degree of formal organization of fire radio networks varies widely. Many have been formed as a result of unstructured evolutionary growth, and in these cases there is little cooperation among users. Others are highly organized and feature strong cooperation. The following basic factors roughly characterize network structure:

(a) Location of dispatching points or those points receiving reports of fire;

(b) Location of base station radio equipment and repeaters or mobile relays;

(c) Number of frequencies or channels in the network; and

(d) Operation of channels that make up the network.

In general, one can consider each factor to be independent of the others. For each, there exists a pair of tradeoffs

that should be considered when building a network, such as the following pairs:

(a) Dispersed or central location of dispatching points;

(b) Dispersed or central location of base station equipment;

(c) Single- or multi-channel networks; and

(d) Simplex or duplex operation of the channels.

Other design considerations can include the following:

(a) Types of interference to which the network is susceptible;

(b) Available methods of channel isolation to prevent interference within the network;

(c) Performance under heavy message loads;

(d) Radio coverage characteristics;

(e) Existence, or nonexistence, of mobile-to-mobile and base-to-base communications in the network; and

(f) The use of special devices (such as facsimile equipment) within the network.

**4-4.1** Radio systems differ by the number of frequencies used to provide a base-mobile channel, by the number of two-way channels in a system (or network), by whether system operation is simplex or duplex, and by whether or not repeater stations are used. The most commonly encountered systems are:

(a) Single-frequency simplex (simplex means that signals can be transmitted in only one direction at a time between two users);

(b) Two-frequency simplex; and

(c) Two-frequency half-duplex (duplex means that signals can pass in both directions at the same time between two users).

**4-4.2** The single-frequency simplex system, the most widely used two-way radio system, uses the least radio spectrum space and is the most economical two-way system to purchase and operate. With this system, the base station and mobile units share the same channel (frequency). This means that only one user of the system can transmit at any one time. Multiple transmissions usually will interfere with each other. All receivers within range can listen to the same transmission, somewhat like many people listening to the same station on their home radios. Under this method, communication is three-way: base to mobile; mobile to base; and mobile to mobile. Single-frequency operation is advantageous to fire departments because all units covering on a fire location are kept informed of all messages that affect the fire-fighting operation. (*See Figure 4-4.2.*)

**4-4.3** The two-frequency simplex system is similar to the single-frequency simplex system except that the base station broadcasts to the mobile units on one frequency, and they broadcast to the base station on a different frequency. This prevents base station broadcasts of one department from interfering with mobile unit broadcasts of another department when they are nearby and share the same frequencies. Thus, it is suited to areas that have densely packed stations on the same frequency. A disadvantage of this mode of operation is that mobile units cannot hear each other's transmissions because their receivers are tuned to the frequency of the base station transmitter.

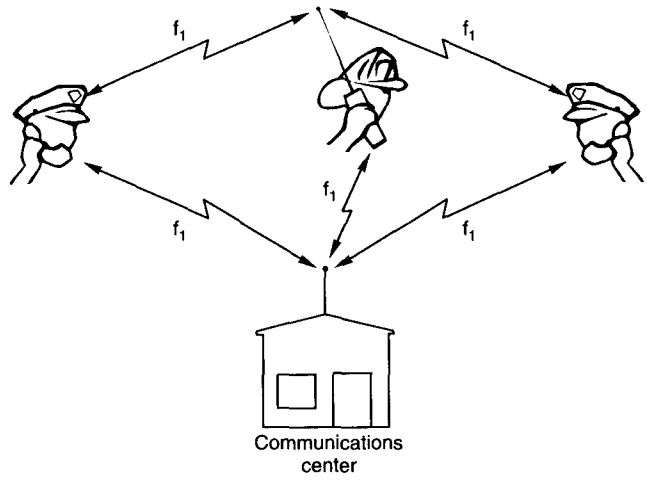


**Figure 4-4.2 Single-frequency simplex operation.**

**4-4.4** A third radio system is the two-frequency half-duplex system. It differs from its simplex counterpart in that operation at the base station is duplex; that is, the base station can receive and transmit simultaneously. If a large geographic area is to be covered by radio communications, or if obstructions such as mountains separate the service area, it might be necessary to use one or more repeater stations to amplify signals and rebroadcast them. Repeater stations can also be used to ensure complete coverage by low-powered portable radios.

**4-4.5** Because of the relatively small number of frequencies available for the fire service, it is not possible for every fire department to have its radio system operating on a separate frequency that is free from interference and not used by any other fire department. A group of small fire departments adjacent to each other should operate on a single frequency for coordination of response under mutual aid arrangements. (All fire departments operating their own radio service, or departments operating in a group, should have one or more separate frequencies and additional frequencies where the radio traffic load warrants.) The disadvantage of a single-frequency group system is that during normal periods, each department will hear the calls of all other fire departments. This can be annoying and can interfere with fire-fighting emergencies arising simultaneously in two or more jurisdictions. In planning to operate on a single frequency, a group of fire departments should prepare a set of rules or operating procedures that each can follow.

**4-4.6** Under FCC rules and regulations, a fire frequency utilization plan can be filed for the state. Under such a plan, the state is divided into fire districts or counties used as fire districts. A common or intradistrict frequency is designated for each district, with one or more frequencies assigned for interdistrict or intrastate communications. The setup in a district will vary with the size of the fire departments, the radio traffic load, and normal mutual aid operations between various individual places. Experience has shown that 15 to 30 radio-equipped vehicles can operate at a fire or emergency on one frequency, but more vehicles result in a message load too great for one frequency. Multi-channel radios should be purchased.

**4-4.7** A group of fire departments can choose to operate a regional communications system. Each group should designate a communications coordinator to assist in planning intradistrict and interdistrict communications. A location should be selected as the communications center for the region. Each region should be allocated a common, or intraregion, frequency, and there can be one or more frequencies assigned for interregion or intrastate communications. System planning on a regional basis is necessary if channel overloading and overlap of tone coding is to be prevented in the future. This guide cannot possibly, nor is it intended to, cover the many technical details of system design. A qualified communications engineer or technician should always be consulted for system technical aspects.

**4-5 Radio Equipment.**

**4-5.1 Vehicular Two-Way Radios.** Radio equipment installed in vehicles is used by field personnel to communicate with the communications center and with each other. These units are indispensable links of the communications chain that aid supervisory personnel in command and control of personnel and equipment in the field. Selective calling, an option offered by some manufacturers, allows mobile units to be called individually. Selective calling is usually coupled with a recall feature that informs an individual who is away from the vehicle of a call by activating the dome light, headlights, siren, or horn.

**4-5.2 Portable Two-Way Radios.** The portable two-way radio has become common in fire department and other public safety radio systems. These are designed with self-contained power supplies and antennas, making them suitable for independent operation. Size and weight are kept low enough so these units can be carried by field personnel, providing two-way radio communication to the person on foot. They vary in power output. Multi-channel radios should be purchased. Some portable units can be connected easily to draw power from a vehicle's electrical system and contain other features that make them suitable for vehicle usage. Selective calling is available as an option.

Units can be purchased with relay capability and used as mobile extenders where the portable unit activates the mobile unit as a relay point.

**4-5.2.1** Fire departments can use portable radio equipment even though they have no base station or vehicle radios. Three frequencies have been designated for intersystem operation only: 154.265 MHz; 154.280 MHz; 154.295 MHz. Use is primarily base to portable and portable to base. Units on these frequencies are useful for local interagency cooperation in order not to interfere with the main radio system or when the heavy message load on the regular radio system would not permit use of portable units. Fire agencies can license portable units on the same frequency as vehicular units so they can be used from widespread locations.

**4-5.3 Pagers.** Pagers, commonly called beepers, can be used for contacting fire personnel. Some can also receive a brief message (voice or data) at the end of the attention tone.

**4-5.4 Mobile Communication Centers.** Emergency situations resulting from large fires, transportation accidents, floods, severe storms, and other disasters often create a need for a temporary communications center located close to the scene of the disaster. This need is filled by a communications vehicle, sometimes called a mobile command post. The vehicle, a mobile command and control headquarters, serves as the hub from which activities necessary to control an emergency situation can be directed and coordinated without dependence upon the department's fixed communications center. These activities include the efforts of local and outside departments and of other public safety organizations, such as police departments and emergency management agencies, in addition to public utilities. Being near the site of the disaster gives communications vehicle personnel and those in command immediate access to the latest information in situations where rapid change is occurring. Further, the ready availability of communications provides the means to call for additional help or to inform other jurisdictions of the situation.

**4-5.4.1** A communications vehicle should carry a variety of equipment that allows communication with other fire departments, public safety organizations, and utilities. Other equipment that can increase the flexibility of the system are citizen band (CB) transmitters and cellular telephones. Some vehicles might be equipped for mobile relay operation that can allow them to pick up transmissions of mobile units and retransmit them at higher power levels or on different frequencies to the communications center. Public address systems for directing personnel and for crowd control are useful. Commercial radio and television receivers and service telephones (provided by the phone company at the site) also are valuable in some situations.

**4-5.4.2** In areas where telephone lines are unavailable, cellular, radio-telephone, or microwave equipment can be employed to obtain telephone service. Since a normal power supply might not be available, an independent power supply system should be incorporated. The vehicle might have provisions for more than one dispatcher with a communication center type of arrangement. If it is to serve as a temporary headquarters, the vehicle should contain chairs and one or more work tables so that maps and other large documents can be studied. Adequate lighting is also necessary. Some emergency situations might warrant use of the vehicle for extended periods of time. Under such conditions, it is advantageous if the vehicle is self-contained, with heating, cooling, kitchen, sanitary, and sleeping facilities for personnel. In some jurisdictions or departments, very complex communications vehicles have been developed, which can accommodate multiple telephone lines, computer terminals, etc.

**4-5.5 Scanning Receivers.** A scanning receiver provides the capability of monitoring several channels automatically. With numerous fire departments using different frequencies, these receivers provide economical means of intercommunications and mutual aid cooperation. Some scanning receivers sample each channel sequentially, waiting for a signal to appear. As soon as a signal is detected, the receiver locks to that channel and stops scanning as long as the signal remains. Some scan with priority, with one channel taking precedence over the others when signals appear simultaneously on both the priority channel and on another. If the receiver is monitoring a nonpriority channel and a signal is heard on the priority channel, the nonpriority channel is released and the priority channel held. Scanning receivers have controls to include or delete channels from the scanning process; thus, one, several, or all

channels can be monitored, allowing operational flexibility for different situations. Frequency synthesized scanning receivers are available that can be set to include virtually any channel in the low VHF, high VHF, or UHF bands. The active channels are selected by the operator and do not need crystal or other changes by a technician. The scanning receivers can provide communications between cooperating agencies without the need for multi-channel transmitters, up to a point. That is, each agency transmits on its own assigned frequency but the transmissions are received by anyone equipped with a scanner. The addressed party then transmits on its own frequency and is likewise received on the other scanners.

**4-5.5.1** Separate scanning receivers programmable by the operator have one major fault, they cannot and should not be depended upon for a primary channel. Although they are generally as sensitive (able to pick up weak signals) as the most expensive radio receivers, they are not as selective (able to reject adjacent channels). Thus, many multi-channel receivers might completely fail to do the job when placed in an environment in close proximity to transmitters transmitting only 15 KHz to 30 KHz apart.

NOTE: The above does not apply to built-in scanning receivers associated with transmitters in a standard mobile or portable radio configuration. These are very selective, but the operator must remember that a scanning receiver can only receive one channel at a time and will lock out all others (except a priority one if so equipped).

**4-5.6 Special and New Devices.** There are many areas of advancing technology that have found, and will continue to find, direct application to fire department systems. Among other things, technology has provided fire departments the ability to:

(a) Keep in constant contact with all personnel and equipment, either in mobile units or on foot;

(b) Exchange data messages between vehicles and base stations;

(c) Improve command and control by television transmission of fire activity to communication centers;

(d) Facsimile transmission of maps, preplans, and other written data; and

(e) Provide vehicle tracking and geographical locations, which may include geographic positioning systems (GPS).

**4-5.6.1** Computers can provide users with a powerful array of intra- and interagency capabilities. Some examples of fire service programs that can be used on these systems are:

(a) Computer-aided dispatch (CAD);
(b) Resource management;
(c) Incident reports;
(d) Equipment and personnel data; and
(e) Hazardous materials information.

In multiple-agency environments, computers can be interconnected (networked) to provide an electronic coordination and information system. These systems have become popular and easy to obtain.

**4-5.6.2** Departments contemplating the purchase of any computer system should make a detailed needs analysis before purchase. Consideration should be given to alternative methods to accomplish the same needs.

**4-5.6.3** Digital computer systems are available that reduce the system's "on" time, can automatically send and receive messages, and provide a hard copy printout of the message. They also provide a degree of communication security, since the transmissions are in digital format rather than voice.

**4-5.7 Tone Signaling and Tone Code Squelch.** Coded audible and subaudible tones sent prior to or during transmission time are used in fire radio systems to implement a number of functions not obtainable with voice alone. Tone coded squelch, recall, radio relay control, and remote transmitter keying are examples of tone coding applications. An encoder is needed for transmission of the coded tones, and a decoder is necessary in the receiver to interpret the coded tones. Some tone coded squelch and tone signaling schemes employ single tones sent continuously with regular voice transmission; some use two simultaneous tones with different frequencies. In another variation, two sequential tones are sent: first one, then the other.

**4-5.7.1** The purpose of tone coded squelch is to eliminate nuisance interference by other users of the radio channel. The receiver is equipped with a decoder that responds only to proper tone coding. When a signal with correct coding is detected, the receiver squelch opens and the desired signal is heard. The squelch cannot be opened by signals without correct coding. Tone coding can be used for selective calling and recall. In a system with selective calling, the base station is equipped with a tone encoder console capable of generating a number of different code combinations. Particular receivers at fixed locations, or at mobile radios, can be provided with unique decoders corresponding to selective codes. The decoder only allows a properly coded signal to be heard at the receiver output. This system gives the base station the ability to call one or a group of receivers and mobile radio units at a time rather than all simultaneously. At fixed locations, selective calling can be used to turn on alarms, sound sirens, turn on lights, open station doors, etc. Most selective call decoders for mobile units provide a recall feature that alerts individuals to a message when they are out of the vehicle. When in the recall mode, the receipt of a properly coded signal causes activation of a call indicator light, horn, headlights, or dome light of the vehicle.

**4-5.7.2** Tone signaling decoding techniques are sometimes used for remote control of base station transmitters. The need for special and costly direct-current telephone lines to provide for transmitter keying from a remote dispatch point is eliminated. The ordinary voice-grade telephone line, which carries voice information to the transmitter, is used to carry the tone also. A simple encoder at the communication center generates a tone when the push-to-talk switch on the microphone is actuated. This tone is sensed by a decoder at the remote base station, causing the transmitter to be activated.

**4-5.8 Maintenance.** Ordinarily, three methods of maintaining communications system equipment are used:

(a) The department operates its own service facilities.

(b) One or more technical service companies are called upon to maintain the department's equipment. In some instances, a combination of department operated and contracted maintenance service is used.

(c) Several departments, a municipality or county, or other agency operate the service facilities. This might result from a contract among several agencies for a jointly operated maintenance department, or it might be part of a more extensive joint operation of fire communications facilities. A county or other governmental unit might have a communications department that provides services for all of its governmental communications systems.

**4-5.8.1** Major components of a communications system can be expected to fail despite the best maintenance program. Component failure should not produce a system failure if proper preparations are made for such events. Standard techniques to prevent system failure are to provide backup equipment and system redundancy.

**4-6 Citizen Cooperation and Assistance.** Two important adjuncts to a communications system under emergency conditions are the Citizens Radio Service, generally known as "CB" for citizen band radios, and the Amateur Radio Service, otherwise known as "hams."

**4-6.1** Citizens band radio is a short-range service. CB radios are widespread and can be used to relay emergency messages. An emergency channel (Channel 9) is reserved for such messages. Radio Emergency Associated Citizens Teams (REACT) are groups of CB radio owners organized to provide an emergency or public service. A CB radio at the station or dispatch center tuned to the emergency channel or an agreement with a local CB group, REACT group, or other group of enthusiasts to relay any emergency information or participate in emergency operations can be very helpful.

**4-6.2** Amateur radio is the personal use of shortwave radio equipment for direct, worldwide communications on a one-to-one basis. Licensed amateurs are allowed up to 1000 watts of input power; have no channel, distance, or time restrictions; and are actually encouraged to modify and experiment with their equipment.

**4-6.2.1** The Amateur Radio Emergency Service (ARES) consists of licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service when disaster strikes. The possession of emergency-powered equipment is desirable. An emergency coordinator represents the ARES in its dealings with civic and relief agencies.

**4-6.2.2** The Radio Amateur Civil Emergency Service (RACES), administered by the Federal Emergency Management Agency of the United States government, is a part of the Amateur Radio Service that provides radio communications for civil preparedness purposes only during periods of local, regional, or national civil emergencies. These emergencies are not limited to war-related activities but can include natural disasters such as fires, floods, and earthquakes. RACES is a radio communication service conducted by volunteer licensed amateurs designed to provide emergency communications to local or state emergency management agencies. RACES' operation is authorized by the FCC upon request of a state or a federal official and is strictly limited to official emergency management activity in the event of an emergency communications situation.

The local amateur club or enthusiasts should be consulted in advance to determine their capabilities and willingness to help where needed.

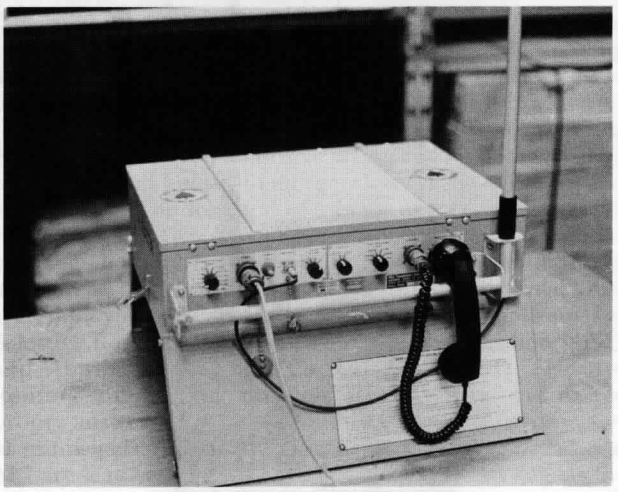

**Figure 4-7(a) Portable repeater unit.**

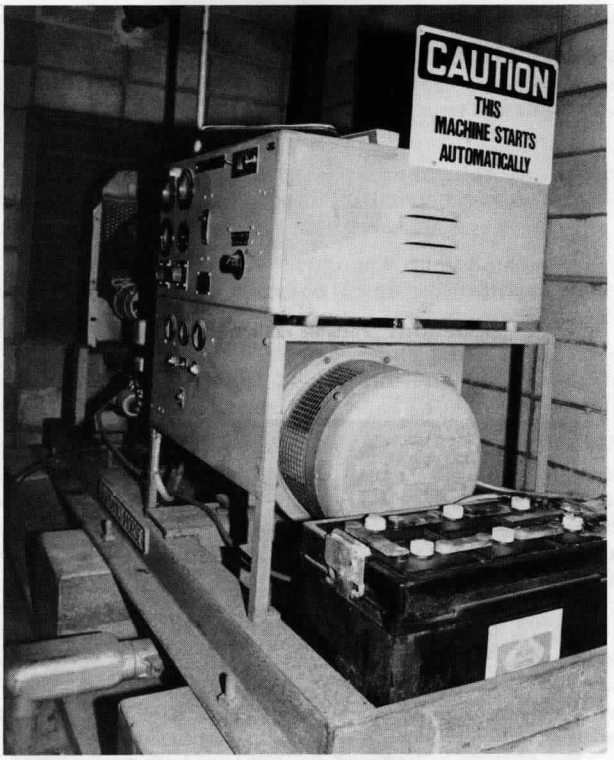


**Figure 4-7(b) Emergency standby electric power generator.**


Figure 4-7(c) Portable radio in charger base.

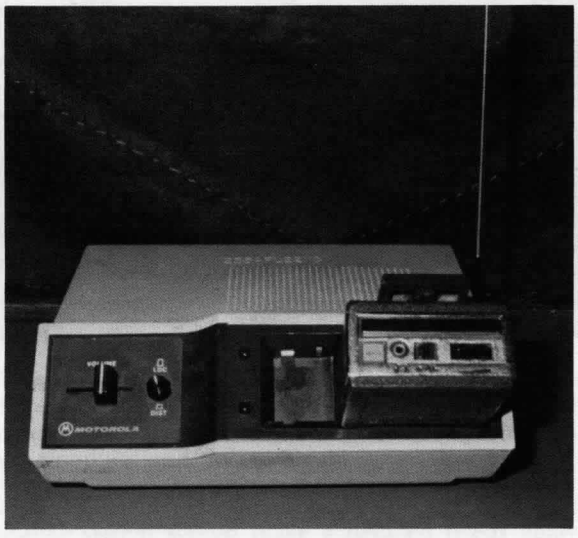


Figure 4-7(d) Tone-encoded fire department pager with amplified charger base.

Figure 4-7(e) Multi-frequency mobile radio control head with electronic siren/public address system; and programmable scanner, portable radio with built in charger, and cellular telephone.

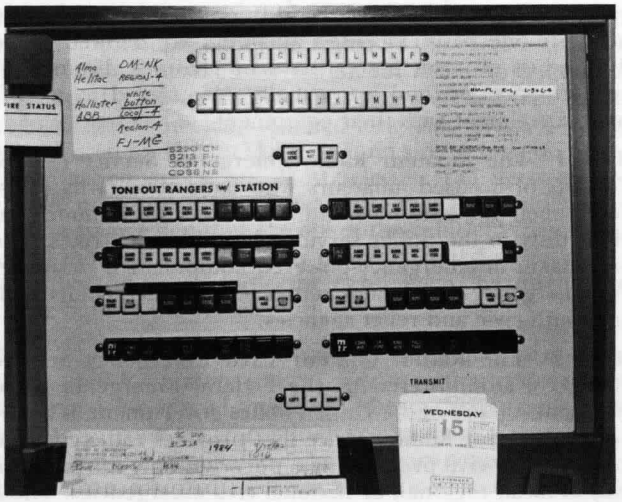


Figure 4-7(f) Tone encoder panel.

**Figure 4-7(g) Dispatch and communication console with multi-line telephone system, computer-assisted dispatch, built in tone encoding panel, fax machine, and digital playback recorder.**

## Chapter 5 Operations and Procedures

**5-1 Communication Centers.** There must be a communication center, or a definite location established, where all calls by telephone, radio, or fire alarm system are received and action taken. This location should be constantly attended during the time it is needed. Suitable expansions can be utilized as necessary.

The complexity and size of the communication center will vary with different jurisdictions. While a large communication center might be staffed 24 hours a day by several operators, other jurisdictions might use a continuously attended watch desk in a fire station. The staffing needs for watch desk operators or communication center operators pose problems for departments with limited funds and limited full-time personnel. Some jurisdictions solve this problem by having one center handle the emergency calls of all public safety or emergency organizations. Another solution for fire departments is to have a number of neighboring fire departments operate a joint communications center. To achieve maximum value from limited facilities, fire departments can pool operations with mutual aid arrangements, which are facilitated when a common communication center is used. There are many regions and rural and suburban areas, for example, where no one fire department can afford a communications center. However, they could establish a multi-jurisdictional communications center and share the expense.

**5-1.1** Populated areas frequently extend over several contiguous communities with multiple fire jurisdictions. A telephone company does not limit or separate services on the basis of municipal boundaries. The continued expansion of the public telephone network might cause calls to a telephone company operator to be routed to a distant location. A person dialing the telephone company operator to report a fire is not assured that the operator will be able to transmit the alarm to the proper fire department.

Fire departments and other public safety services recognize the need for the public to be able to reach them quickly, no matter where they are when an emergency arises. In January 1968, a proposal was made to implement throughout the country a single national emergency number that the public could use to reach the police, fire department, and other emergency agencies from wherever they might be. The number 9-1-1 was chosen. The 9-1-1 system is an easy-to-remember, three-digit telephone number used to provide the general public with direct access to the emergency service resources.

The call for help terminates at a Public Safety Answering Point (PSAP) where responsive action can be initiated. This point serves all kinds of emergency services — fire, police, medical, etc. The selection of a point to receive emergency calls raises the problem of jurisdiction because telephone exchange boundaries often include several communities or large areas. For this reason, some multi-jurisdictional areas are employing enhanced 9-1-1 telephone features such as Selective Routing, Automatic Number Identification (ANI), and Automatic Location Identification (ALI). Selective Routing automatically routes an emergency call to the proper answering point serving its community, irrespective of municipal and telephone boundary conflicts. ANI and ALI are features that automatically identify and display the telephone number and location of the emergency call. These enhanced 9-1-1 features can result in the overall reduction of emergency response time.

After a call for help has been received at a PSAP, there are several methods by which it can be handled. These are:

(a) *Direct Dispatch Method.* The dispatch personnel at the central answering point perform all call answering and dispatching of an appropriate emergency service unit upon the receipt of a telephone request.

(b) *Relay Method.* A telephone request for emergency services is relayed to appropriate safety agencies for dispatch of an emergency service unit.

(c) *Transfer Method.* A telephone request for emergency service is directly transferred to an appropriate safety agency.

(d) *Referral Method.* The requesting party is provided with the telephone number of the appropriate safety agency in nonemergencies.

**5-2 Summoning Volunteers.** Fire departments with volunteers or paid-call fire fighters have the responsibility of summoning their personnel at any hour of the day or night. This problem can be solved by the use of the telephone or radio, supplementing siren or horns that give an outside alarm. Fire calls can be telephoned to the central telephone office where the telephone operator can start a siren or operate an air horn, indicating that there is a fire. In areas where a communications center is not attended 24 hours a day, telephone companies can provide a special telephone line that connects to special telephones located in places of business or residences selected by the jurisdiction. The jurisdiction then arranges to have reports of fire acted upon. In fire departments that have a fire station desk attendant, the telephone central operator can call the station, and the attendant can sound the outside alarm to call volunteers. If there is a code-sounding siren or air horn, coded signals can be sent. Usually a transmitting apparatus is used to send out the code.

If radio equipment is used, a receiver with selective calling equipment can be placed in the home of each volunteer or call fire fighter. Selective signaling is accomplished on a

group-call principle, permitting the volunteer or call forces to be divided into several groups that can be summoned as a whole or as individual groups to take care of a particular incident. Pagers are in common use for this purpose since they can be carried anywhere. These units might include either a tone alarm, a voice receiver, or digital display.

**5-3 Fire Ground or Other Incident Communications.** The first unit to arrive at a fire or other emergency incident should notify the communications center by radio of its arrival and give a brief description of the conditions visible and the precise location of the incident. The responding officer should report arrival and should establish the initial command post at the fire or other emergency. As soon as conditions allow, the incident commander should report supplementary information to the communications center and should make additional progress reports if operations keep the fire units at the emergency beyond a few minutes. An extended or complex emergency incident might necessitate the use of a communications van for effective coordination, command, and control.

**5-3.1** The assignment of a communications officer to incidents that are more complex will ensure that adequate communication is achieved, utilizing both available telephone and radio systems, and that the availability of existing frequencies or networks is maximized and system overloading is minimized. An assigned communications officer can be particularly important and useful on multi-agency fires and other incidents. It might be necessary to establish specific nets and monitoring systems to guarantee communications in some situations. In complex incidents, communications discipline is most important to avoid system overloading.

**5-3.2** The common emergency organization, the Incident Management System (IMS), includes two important communications concepts:

(a) *Common Terminology.* All participating departments and agencies use clear text radio and established standard terms and phrases. In multiple-agency emergencies, it is extremely difficult to guarantee that all agency and department codes portray exactly the same meaning. To avoid any potential misunderstandings between cooperators, the ICS requires clear text or plain language for all radio messages. Although this is a significant departure from public safety agency tradition, it has been found to be very efficient in actual practice.

(b) *Integrated Incident Communications.* Participating departments and agencies plan in advance for the use of integrated radio frequencies to tie together all tactical and support units on an incident. To ensure the best possible use of all participating department and agency radios on major incidents, an Incident Radio Communications Plan matrix is developed. This matrix lists all available radio systems on an incident and aids in assigning them to provide command, tactical, and logistical coverage for a complete operation. Preparation of the matrix requires training and a knowledge of cooperating department and agency frequencies and radio components. Use of the matrix is greatly enhanced by the existence of a frequency-sharing agreement. (*See Appendix B.*)

The FCC has no prohibition against public agencies sharing frequencies during emergencies provided that the responsible agency has granted permission to do so to assisting agencies. The agreement specifies the mutual permission of participating agencies to use other agencies' frequencies when assisting them. The agreement lists the terms and conditions of use by others and includes all frequencies that could be made available under critical conditions. Agreements such as this facilitate better multi-agency dispatching and incident communications and can be prepared by groups or agencies who frequently work together.

**5-4 Communication Center Operations.** Fire departments should adopt a standard procedure for operations of the communication center. The adoption of standard words in voice communications is important to speed message transmission and avoid errors. With voice communication it is necessary to phrase messages so they will not be misunderstood. Standard messages are used not only to use the communications facilities efficiently, but also to make sure that the standard message can be defined. The department's standard procedures should define how persons originating a message will identify themselves.

**5-4.1** Communication center dispatchers must know the capabilities and limitations of the communications systems that they are authorized to operate. They must be familiar with the administrative organization of the agency so as to be able to route traffic properly and be aware of the equipment and resources available to the agency, and they must be familiar with the capabilities of cooperating agencies and with the applicable rules and regulations of the FCC.

**5-4.1.1** Many calls from the public are clearly of an emergency nature. Some calls are not of an emergency nature, thus reducing the need for priority handling. Some calls are not clearly in either the emergency or nonemergency category. A dispatcher cannot assume that the call is not urgent. All such doubtful calls must be treated as if they were urgent, representing true emergencies. Many calls to the fire emergency telephone number might be merely requests for information. The dispatcher answering the phone generally must transfer all nonemergency calls as quickly as possible to a nonemergency operator or agency.

**5-4.1.2** Dispatchers should possess the following basic qualifications:

(a) Ability to speak clearly and distinctly at all times;

(b) Ability to reduce rambling and disconnected material into concise and accurate messages;

(c) Ability to think and act promptly in emergencies;

(d) Ability to analyze a situation accurately and to take or suggest an effective course of action;

(e) Thorough understanding of the capabilities of the agency's own communications system and a working knowledge of mutual aid systems;

(f) Adequate understanding of the technical operation of the department's own system to facilitate reporting of equipment failures;

(g) Ability to work effectively under all conditions encountered; and

(h) Knowledge of the FCC rules and regulations applying to operator's responsibilities.

**5-5 Basic Telephone Techniques.** The telephone is the most available means of access the public has to obtain the services of the fire department. The telephone is also the

fundamental method of communication within a department and between departments and agencies.

Fire department personnel using the telephone should adhere to the following rules:

(a) *Answer Promptly.* Treat each call as an emergency. Every ring for the person who might be ill or suffering from fear or panic seems like an eternity.

(b) *Identify Yourself and Your Department.* This assures the caller that the call was placed properly.

(c) *Speak Directly into the Mouthpiece.* This ensures that you will be understood and will not waste time repeating information.

(d) *Observe Telephone Courtesy.* Use a calm, competent, decisive voice in a courteous manner.

(e) *Take Charge of the Conversation.* After the initial exchange, lead the call into meaningful context by asking questions as to who, what, where, and when. Be courteous but firm.

(f) *Record All Information.* Never leave anything to memory.

(g) *Explain Waits.* Explain why it will take time to check for information and that you will call back. A party waiting on a "dead" phone might become irritable and uncooperative.

(h) *Avoid Jargon or Slang.*

(i) *Show Interest in the Person's Call.* The person calling has or needs information and feels it is important.

(j) *Use Caller's Name when Possible.* This makes the caller feel that you have a personal interest in the call.

(k) *Try to Visualize the Caller.* The telephone is an impersonal thing and we tend to be curt or less courteous or to lose our temper more easily than if we were meeting the party in person.

(l) *Make Sure the Information Gets to the Proper Person.* Never give the caller misinformation and never guess, but refer the call to the proper party even if it means transferring the call.

(m) *Advise when You Leave Your Position.* Let your co-workers know of your whereabouts when leaving your position.

(n) *List Frequently Called Numbers.* Place such numbers, as well as all other important numbers, within view of the operating position.

(o) *Transfer Calls Only when Necessary.* When it is necessary to transfer a call, tell the caller what you are going to do.

(p) *Terminate Calls Positively and Courteously.* Verify critical information before terminating a call.

**5-6 Basic Radio Techniques.** FCC rules and regulations govern the operation of fire services radio, and a copy of the rules should be maintained at the communication center. In addition, certaln rules that are based on common courtesy and achieving maximum efficiency from the system should be observed. Good radio practices include the following:

(a) Always be courteous.

(b) Use proper language. The use of profanity is prohibited by the FCC. This rule is enforced. Violations can and do result in fines, imprisonment, or loss of license.

(c) Answer radio calls promptly.

(d) Think through your message before starting to transmit. Be brief and to the point. Radio channels are crowded. Use brief phrases whenever possible to condense your messages.

(e) If radio dead spots or interference are encountered, move the vehicle and try again. Sometimes only a few feet can make a considerable difference. Many vehicles have directional radio patterns, either toward the front or rear, depending on location of the antenna. Changing vehicle direction can sometimes assist in getting a signal to the base station.

(f) If others are using the air, wait until they are through unless your message is of an emergency nature. If it is, break in on the conversation and request a clear frequency for emergency traffic. Always listen first to be sure the channel is clear before you attempt to transmit.

(g) Pronounce your words distinctly and rather slowly. Talk into the microphone; use a normal tone of voice. Shouting or yelling into the microphone will cause an extremely distorted signal and should be avoided. It is also essential that your voice maintain a constant volume that does not trail off. Do not become excited.

(h) Do not carry on discussions unrelated to department activity. Only pertinent communications are permitted. FCC rules do not permit transmission of messages for unlicensed parties (except in emergency situations) or the transmission of music or commercial messages.


**Figure 5-7(a) Incident communications and resource situation/status unit, Southern California FIRESCOPE Project.**

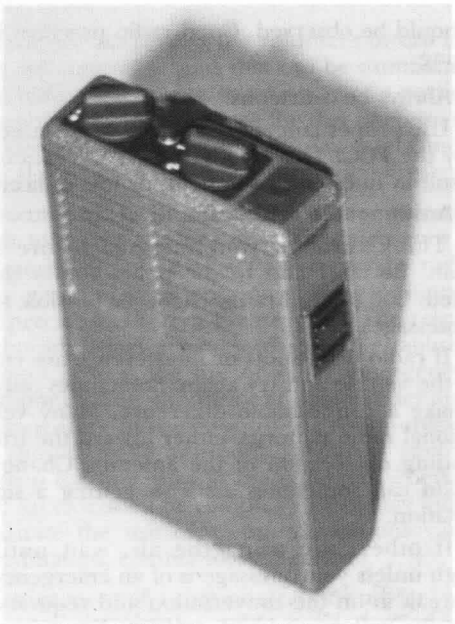

Figure 5-7(b) Tone-encoded pager.


Figure 5-7(c) Digital pager.


Figure 5-7(d) Mobile Incident Command and Communications Unit.

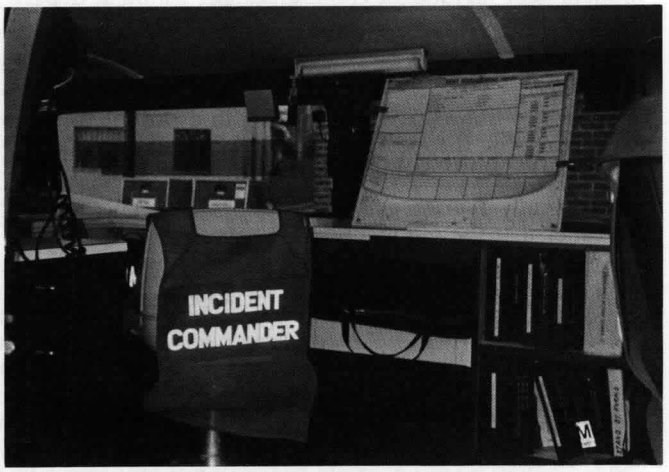


Figure 5-7(e) Radio operator's desk with cooperating agency's radio, tone encoder, and portable base station as installed in mobile incident command/communications unit.

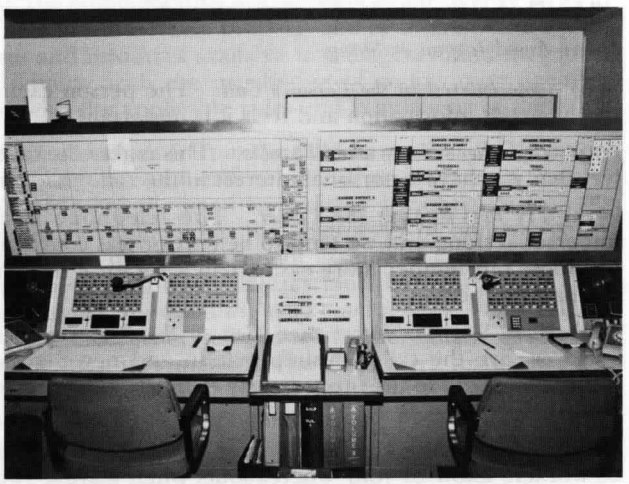

Figure 5-7(f) Two-position dispatch and communications console with resource directories, tone encoder, tape recorder, and resource/situation display.

## Chapter 6 Referenced Publications

**6-1** The following document or portions thereof are referenced within this guide and should be considered part of the recommendations of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**6-1.1 FCC Publication.** U.S. Government Printing Office, Washington, DC.

*Code of Federal Regulations*, Federal Communications Commission, Title 47, Part 90, "Private Land Mobile Radio Services," 1990.

## Appendix A Public Safety Communication Languages

*This Appendix is not a part of the recommendations of this NFPA document but is included for informational purposes only.*

There is a need for intercommunication between agencies in the Public Safety Radio Services. The most efficient service rendered to the public in a given area exists when all the resources of public safety can be coordinated. Communication is a vital link in this coordination process, be it by radio, telephone, or other means. It is essential that the operator of one system be able to understand the language of other systems. The only efficient and accurate method of reaching understanding is for these operators to speak the same language.

The best method of providing a common language is through the use of plain language.

### The International Phonetic Alphabet

The phonetic alphabet should be used for spelling out unusual names of persons and locations. The names used after each letter have been found to be the most understandable over the air. They should always be given as "A — Alpha, B — Bravo," never "A as in Alpha" or "B as in Bravo," etc. The alphabet is easily memorized.

| Letter | Identifying Word | Spoken as * |
|---|---|---|
| A | ALPHA | Al *fah* |
| B | BRAVO | *Brah voh* |
| C | CHARLIE | *Char* lee (*Shar* lee) |
| D | DELTA | *Dell* tah |
| E | ECHO | *Eck* oh |
| F | FOXTROT | *Foks* trot |
| G | GOLF | Golf |
| H | HOTEL | Hoh *tell* |
| I | INDIA | *In* dee ah |
| J | JULIETTE | *Jew* lee *ett* |
| K | KILO | *Key* loh |
| L | LIMA | *Lee* mah |
| M | MIKE | Mike |
| N | NOVEMBER | No *vem* ber |
| O | OSCAR | *Oss* cah |
| P | PAPA | Pah *pah* |
| Q | QUEBEC | Keh *beck* |
| R | ROMEO | *Row* me oh |
| S | SIERRA | See *air* ah |
| T | TANGO | *Tang* go |
| U | UNIFORM | *You* (*Oo*) nee form |
| V | VICTOR | *Vik* tah |
| W | WHISKEY | *Wiss* key |
| X | XRAY | *Ecks ray* |
| Y | YANKEE | *Yang* key |
| Z | ZULU | *Zoo* loo |

*The syllables to be emphasized are italicized.

### Standard Numerical Pronunciation

| | |
|---|---|
| 1 - "WUN" | emphasizing W and N |
| 2 - "TOO" | emphasizing long OO |
| 3 - "TH-R-EE" | generally rolling R, long EE |
| 4 - "FO-WER" | long O, emphasizing W and R |
| 5 - "FIE-YIV" | long I, emphasizing Y and V |
| 6 - "SIKS" | emphasizing S and KS |
| 7 - "SEV-VEN" | emphasizing S and V with clearly spoken VEN |
| 8 - "ATE" | long A, emphasizing T |
| 9 - "NI-YEN" | emphasizing N, long I, with clearly spoken YEN |
| 0 - "ZERO" | emphasizing Z, with a brief RO |

### 2400 Hour Time

| 2400 Hour Time | 12 Hour Time |
|---|---|
| 0000 | Beginning of day |
| 0001 | One minute after midnight (zero zero zero one) |
| 0015 | Quarter past midnight (zero zero one five) |
| 0045 | 45 minutes past midnight (zero zero four five) |
| 0100 | One o'clock in the morning (zero one hundred) |
| 0130 | One-thirty AM (zero one three zero) |
| 0200 | 2 am (zero two hundred) |
| 0300 | 3 am |
| 0400 | 4 am |
| 0500 | 5 am |
| 0600 | 6 am |
| 0700 | 7 am |
| 0800 | 8 am |
| 0900 | 9 am |
| 1000 | 10 am (ten hundred) |
| 1100 | 11 am (eleven hundred) |
| 1200 | Noon |
| 1201 | One minute after noon (twelve zero one) |
| 1215 | Quarter past noon (twelve fifteen) |
| 1300 (add 100 to 1200) | 1 pm (thirteen hundred) |
| 1345 (add 0045 to 1300) | 1:45 pm (thirteen forty-five) |
| 1400 (add 200 to 1200) | 2 pm |
| 1500 (add 300 to 1200) | 3 pm |
| 1600 (add 400 to 1200) | 4 pm |
| 1700 (add 500 to 1200) | 5 pm |
| 1800 (add 600 to 1200) | 6 pm |
| 1900 (add 700 to 1200) | 7 pm |
| 2000 (add 800 to 1200) | 8 pm (twenty hundred) |
| 2100 (add 900 to 1200) | 9 pm (twenty-one hundred) |
| 2200 (add 1000 to 1200) | 10 pm |
| 2300 (add 1100 to 1200) | 11 pm |
| 2400 (add 1200 to 1200) | Midnight (twenty-four hundred) |

## Appendix B Frequency-Sharing Memorandum of Understanding

*This Appendix is not a part of the recommendations of this NFPA document but is included for informational purposes only.*

This Memorandum of Understanding is between the several partner agencies, which are: _____ Department of Forestry; _____ Office of Emergency Services; _____ City Fire Department; _____ County Fire Department; U.S. Forest Services; (etc.).

The purpose of this Memorandum of Understanding is to establish terms and conditions for use of radio frequencies when partner agencies are engaged in a mutual aid effort on incident(s).

The Reciprocal Fire Protection Act of May 27, 1955 (PL 84-46) authorizes the United States government to enter into this Memorandum of Understanding.

The following terms and conditions are agreed to:

| | |
|---|---|
| _____ | _____ |
| Department of Forestry | County Fire Department |
| Date _____ | Date _____ |
| _____ | _____ |
| Office of Emergency Service | U.S. Forest Service |
| Date _____ | Date _____ |
| _____ | _____ |
| City Fire Department | County Fire Department |
| Date _____ | Date _____ |
| _____ | _____ |
| County Fire Department | County Fire Department |
| Date _____ | Date _____ |

The following radio frequencies are licensed by the FCC under Call Sign _____ to the State of _____, Department of Forestry. _____ is licensed to use them in State of _____ and vicinity with the exceptions noted. Partner agencies are subject to the same limitations. Partner agencies may use these frequencies on Department of Forestry—Partner Agency fires only after permission to use is given by The Department of Forestry Dispatch and Communication Center responsible for the fire.

| RADIO FREQUENCY | EXCEPTIONS |
|---|---|
| 1. _____ | 1. _____ |
| 2. _____ | 2. _____ |
| (etc.) | (etc.) |

## Appendix C Radio Organizations

*This Appendix is not a part of the recommendations of this NFPA document but is included for informational purposes only.*

| | |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials<br>444 N. Capitol St., NW<br>Suite 249<br>Washington, DC 20001 |
| ARRL | American Radio Relay League, Inc.<br>225 Main St.<br>Newington, CT 06111 |
| APCO | Associated Public Safety Communications Officials International<br>2040 South Ridgewood Avenue<br>South Daytona, FL 32119 |
| FCCA | Forestry Conservation Communications Association<br>Virginia Division of Forestry<br>P.O. Box 3758<br>Charlottesville, VA 22903-0758 |
| FIT | Forest Industrial Telecommunications<br>871 Country Club Road, Suite A<br>Eugene, OR 97401 |
| IMSA | International Municipal Signal Association<br>P.O. Box 1513<br>Providence, RI 02901 |
| REACT | Radio Emergency Associated Citizens Teams<br>React International, Inc.<br>3653 Woodhead Dr.<br>Northbrook, IL 60062 |

## Appendix D Referenced Publications

**D-1** The following documents or portions thereof are referenced within this guide for informational purposes only and thus are not considered part of the recommendations of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**D-1.1 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Public Fire Service Communication Systems*, 1994 edition.

NFPA 1561, *Standard on Fire Department Incident Management System*, 1995 edition.

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# The NFPA Codes and Standards Development Process

Since 1896, one of the primary purposes of the NFPA has been to develop and update the standards covering all areas of fire safety.

**Calls for Proposals**
The code adoption process takes place twice each year and begins with a call for proposals from the public to amend existing codes and standards or to develop the content of new fire safety documents.

**Report on Proposals**
Upon receipt of public proposals, the technical committee members meet to review, consider, and act on the proposals. The public proposals – together with the committee action on each proposal and committee-generated proposals – are published in the NFPA's Report on Proposals (ROP). The ROP is then subject to public review and comment.

**Report on Comments**
These public comments are considered and acted upon by the appropriate technical committees. All public comments – together with the committee action on each comment – are published as the Committee's supplementary report in the NFPA's Report on Comments (ROC).

The committee's report and supplementary report are then presented for adoption and open debate at either of NFPA's semi-annual meetings held throughout the United States and Canada.

**Association Action**
The Association meeting may, subject to review and issuance by the NFPA Standards Council, (a) adopt a report as published, (b) adopt a report as amended, contingent upon subsequent approval by the committee, (c) return a report to committee for further study, and (d) return a portion of a report to committee.

**Standards Council Action**
The Standards Council will make a judgement on whether or not to issue an NFPA document based upon the entire record before the Council, including the vote taken at the Association meeting on the technical committee's report.

**Voting Procedures**
Voting at an NFPA Annual or Fall Meeting is restricted to members of record for 180 days prior to the opening of the first general session of the meeting, except that individuals who join the Association at an Annual or Fall Meeting are entitled to vote at the next Fall or Annual Meeting.

"Members" are defined by Article 3.2 of the Bylaws as individuals, firms, corporations, trade or professional associations, institutes, fire departments, fire brigades, and other public or private agencies desiring to advance the purposes of the Association. Each member shall have one vote in the affairs of the Association. Under Article 4.5 of the Bylaws, the vote of such a member shall be cast by that member individually or by an employee designated in writing by the member of record who has registered for the meeting. Such a designated person shall not be eligible to represent more than one voting privilege on each issue, nor cast more than one vote on each issue.

Any member who wishes to designate an employee to cast that member's vote at an Association meeting in place of that member must provide that employee with written authorization to represent the member at the meeting. The authorization must be on company letterhead signed by the member of record, with the membership number indicated, and the authorization must be recorded with the President of NFPA or his designee before the start of the opening general session of the Meeting. That employee, irrespective of his or her own personal membership status, shall be privileged to cast only one vote on each issue before the Association.

## FORM FOR PROPOSALS ON NFPA TECHNICAL COMMITTEE DOCUMENTS

**Mail to: Secretary, Standards Council**
**National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts 02269-9101**
**Fax No. 617-770-3500**

Note: All proposals must be received by 5:00 p.m. EST/EDST on the published proposal-closing date.

**If you need further information on the standards-making process, please contact the Standards Administration Department at 617-984-7249.**

**Date** _____ **Name** _____ **Tel. No.** _____

**Company** _____

**Street Address** _____

**Please Indicate Organization Represented (if any)** _____

**1. a) NFPA Document Title** _____ **NFPA No. & Year** _____

**b) Section/Paragraph** _____

**2. Proposal Recommends: (Check one)**
- ❑ **new text**
- ❑ **revised text**
- ❑ **deleted text**

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**Log #** _____
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**3. Proposal (include proposed new or revised wording, or identification of wording to be deleted):**

**4. Statement of Problem and Substantiation for Proposal:** (Note: State the problem that will be resolved by your recommendation; give the specific reason for your proposal including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

**5. ❑ This Proposal is original material.** (Note: Original material is considered to be the submitter's own idea based on or as a result of his/her own experience, thought, or research and, to the best of his/her knowledge, is not copied from another source.)

**❑ This Proposal is not original material; its source (if known) is as follows:** _____

Note 1: Type or print legibly in black ink.
Note 2: If supplementary material (photographs. diagrams, reports, etc.) is included, you may be required to submit sufficient copies for all members and alternates of the technical committee.

*I hereby grant NFPA the non-exclusive, royalty-free rights, including non-exclusive, royalty-free rights in copyright, in this proposal and I understand that I acquire no rights in any publication of NFPA in which this proposal in this or another similar or analogous form is used.*

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