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Standard Guide for Planning and Developing 9-1-1 Enhanced Telephone Systems[1]

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1. Scope

1.1 This guide recommends minimum performance requirements for enhanced access to public safety services using the North American standard emergency telephone number, 9-1-1.

1.2 This guide provides assistance to states, counties, and local jurisdictions in the development of 9-1-1 enhanced systems.

1.3 This guide makes recommendations for planning and organizational needs in the development of 9-1-1 enhanced systems.

1.4 This guide does not address access to public safety response services through means other than use of the 9-1-1 telephone number.

1.5 This guide applies only to the use of the number 9-1-1 to request a public safety response, from the point of initiation of the call through the point that the caller is connected to the responsible agency, or essential information needed for disposition of the call, or both, is received.

1.6 The sections in this guide are arranged in the following order:

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

2. Terminology

2.1 *Definitions:*

2.1.1 *9-1-1*, *n*—a three-digit telephone number to facilitate the reporting of an incident or situation requiring response by a public safety agency.

2.1.2 *Poisson Distribution*, *n*—a probability density function that is often used as a mathematical model of the number of outcomes obtained in a suitable interval of time and space. In 9-1-1 it is used to predict potential call blockage during normal busy periods.

2.2 *Definitions of Terms Specific to This Standard:*

2.2.1 *abandoned call*, *n*—a call placed to 9-1-1 in which the caller disconnects before the call can be answered by the public safety answering point (PSAP) attendant.

2.2.2 *action agency*, *n*—the public safety agency having a legal or consensual obligation to respond to a call for service.

2.2.3 *alternate routing*, *n*—the capability of automatically rerouting 9-1-1 calls to a designated alternate location(s) if all 9-1-1 trunks from a central office or to a primary PSAP are busy or out of service. May also be activated upon request, or automatically if detectable, when 9-1-1 equipment fails or the PSAP itself is disabled.

2.2.4 *answering position*, *n*—an appropriately equipped location within a PSAP that is used to receive incoming 9-1-1 calls.

2.2.5 *audible signal*, *n*—a sound that indicates an incoming 9-1-1 call.

2.2.6 *automatic call distributor (ACD)*, *n*— equipment that distributes incoming calls to available PSAP attendants in the order the calls are received, or holds calls until an attendant becomes available.

2.2.7 *automatic location identification (ALI)*, *n*—the automatic display at the PSAP of the caller's telephone number, the address for the telephone and supplementary information.

2.2.8 *automatic number identification (ANI)*, *n*—the automatic display at the PSAP of the caller's telephone number.

2.2.9 *average busiest hour*, *n*—the 1-h period during the week statistically shown over time to be the hour in which the most emergency telephone calls are received.

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2.2.10 *call detail logging*, *n*—a means of establishing chronological and operational accountability for each 9-1-1 call processed, consisting minimally of the caller's telephone number, the date and time the 9-1-1 telephone equipment established initial connection (trunk seizure), the time the call was answered, the time the call was transferred (if applicable), the time the call was disconnected, the trunk line used, and the identity of the PSAP attendant's position. Also known as *ANI printout*.

2.2.11 *called party hold*, *n*—the capability to maintain control of an incoming 9-1-1 call by a PSAP attendant for tracing or confirmation of an emergency even if the caller hangs up.

2.2.12 *call progress signals*, *n*—audible cues to advise 9-1-1 users of the status of their calls.

2.2.13 *call relay*, *n*—disposition of a 9-1-1 call by the notation of pertinent information by the PSAP attendant who forwards the information to the action agency.

2.2.14 *call referral*, *n*—disposition of a 9-1-1 call by advice to the caller of the appropriate numbers to call other than 9-1-1.

2.2.15 *call transfer*, *n*—the extending of a 9-1-1 call by a PSAP attendant to connect the caller with the action agency.

2.2.16 *central office (CO)*, *n*—a telephone company facility that houses the switching and trunking equipment serving telephones in a defined area. Also known as *end office*.

2.2.17 *circuit routes*, *n*—a means of two-way communication between two terminal installations.

2.2.18 *class of service*, *n*—a service order code designation of the telephone service features to which business and residence customers subscribe.

2.2.19 *computer-aided dispatch (CAD)*, *n*— a computer-based system intended to increase the efficiency and accuracy of public safety call handling and dispatching.

2.2.20 *computer-aided dispatch (CAD) interface*, *n*—the means of automatically introducing the ALI data into a computer-aided dispatch (CAD) system, as opposed to manually entering the information.

2.2.21 *conference transfer*, *n*—the capability of transferring a call to the action agency and allowing the PSAP attendant to monitor or participate in the call after it has been transferred to the action agency. Also known as *three-way calling*.

2.2.22 *contiguous agency*, *n*—a public safety agency whose jurisdiction is adjacent to the area served by a 9-1-1 system.

2.2.23 *cross tandem transfer*, *n*—the capability of transferring a call over the 9-1-1 network from a PSAP served by one tandem office to another PSAP served by a different tandem office.

2.2.24 *customer comments*, *n*—supplementary information useful in dispatching, provided in conjunction with ALI displays.

2.2.25 *customer premises equipment (CPE)*, *n*— terminal equipment at a PSAP or secondary answering location.

2.2.26 *cutover*, *n*—the actuation of a new telephone call processing or switching system.

2.2.27 *data base*, *n*—a collection of information organized in a computer to facilitate rapid search and retrieval. In this guide, such data bases include MSAG, telephone number/ESN, and telephone customer records.

2.2.28 *data management system (DMS)*, *n*—the combination of manual procedures and computer programs used to create, store, manipulate, and update data required to provide selective routing and ALI.

2.2.29 *dedicated trunk*, *n*—a telephone circuit used for one purpose only; that is, transmission of 9-1-1 calls.

2.2.30 *default routing*, *n*—the capability to route a 9-1-1 call to a designated (default) PSAP when the incoming 9-1-1 call cannot be selectively routed due to an ANI failure, garbled digits, or other cause.

2.2.31 *dial tone first*, *n*—the provision of dial tone to enable a caller to originate and complete 9-1-1 calls from public telephones without inserting a coin or any other device. Also known as *coin-free dialing*.

2.2.32 *direct dispatch*, *n*—the functions of 9-1-1 call answering and dispatching are both performed by personnel at the primary PSAP.

2.2.33 *diverse routing*, *n*—the practice of routing calls through different circuit paths in order to prevent total loss of the 9-1-1 system in the event an individual circuit is disabled.

2.2.34 *emergency service number (ESN)*, *n*— a number used in the DMS to designate the public safety agencies responsible for service to the location of each telephone in a 9-1-1 service area, for the purpose of determining call routing. Also see *emergency service zone (ESZ)*.

2.2.35 *electronic switching system (ESS)*, *n*— a central office with programmable switching logic. Can also be used as a tandem.

2.2.36 *emergency service zone (ESZ)*, *n*—a defined geographical territory consisting of a specific combination of law enforcement, fire, and emergency medical coverage areas. Also see *emergency service number (ESN)*.

2.2.37 ***end office,*** *n*—see *central office*.

2.2.38 *enhanced 9-1-1*, *n*—a telephone system which includes ANI, ALI, and (optionally) selective routing, to facilitate appropriate public safety response.

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

2.2.40 *fixed transfer*, *n*—the capability of a PSAP attendant to transfer a 9-1-1 call to the agency associated with a single button.

2.2.41 *forced disconnect*, *n*—the capability of a PSAP attendant to disconnect a 9-1-1 call to prevent jamming of the incoming lines.

2.2.42 *foreign exchange (FX) service*, *n*— a telephone line switched in an exchange or central office other than the exchange or central office in which the telephone is located.

2.2.43 *interconnect*, *n*—the connection of the serving telephone company's equipment with the equipment of another vendor. Also a generic term used to refer to a non-telephone company vendor.

2.2.44 *interlocal services agreement*, *n*— an agreement among governmental jurisdictions or privately owned systems, or both, within a specified area to share 9-1-1 system costs, maintenance responsibilities, and other considerations.

2.2.45 *logging recorder*, *n*—a device that records date/time, voice communications, and other transactions involved in the

processing of calls to a PSAP.

2.2.46 *main station*, *n*—a telephone that is connected directly to a central office and has a unique telephone number. It is not an extension.

2.2.47 *master street address guide (MSAG)*, *n*— a data base of street names and address ranges within their associated communities defining emergency service zones for 9-1-1 purposes.

2.2.48 *network*, *n*—an arrangement of main stations interconnected by means of communications channels organized to perform or serve a common function.

2.2.49 *nonselective routing*, *n*—the capability of routing 9-1-1 calls by the use of the NXX or trunk group.

2.2.50 *NXX*, *n*—the first three digits of a local telephone number that identifies the central office switching location within its area code. Also erroneously referred to as NNX.

2.2.51 *P.01 grade of service*, *n*—a measure of emergency telephone service in which no more than one call in 100 attempts will be blocked during the average busiest hour.

2.2.52 *pilot number*, *n*—a telephone customer's main account number, lead number, listed number, or billing number.

2.2.53 *private branch exchange (PBX)*, *n*— a private, internally switched telephone system, of significance to 9-1-1 systems because internal stations may not be individually contained in the DMS and, as a result, will not be displayed by ANI or ALI equipment.

2.2.54 *public safety agency*, *n*—an entity that provides firefighting, law enforcement, emergency medical, or other emergency service.

2.2.55 *public safety answering point (PSAP) attendant*, *n*—a person responsible for answering incoming 9-1-1 calls at a PSAP, determining the action to be taken, and executing the PSAP's procedures in the disposition of such calls.

2.2.56 *public safety answering point (PSAP)*, *n*—a facility equipped and staffed to receive 9-1-1 calls. A primary PSAP receives the calls directly; if the call is relayed or transferred the next receiving PSAP is designated a secondary PSAP.

2.2.57 *public switched telephone network (PSTN)*, *n*—the totality of equipment, lines, and controls assembled to establish communication paths between calling and called parties.

2.2.58 *ring back*, *n*—the capability permitting a PSAP attendant to cause the telephone on a held circuit to ring. Also known as *re-ring*.

2.2.59 *selective routing*, *n*—the capability of routing a 9-1-1 call to a designated PSAP based upon the location of the caller.

2.2.60 *selective transfer*, *n*—the capability of transferring a 9-1-1 call to the pre-programmed action agency by operation of one of several buttons typically designated as police, fire, or emergency medical; based on the origin of the incoming call and the nature of the response required.

2.2.61 *serving central office*, *n*—the central office (CO) from which a PSAP is served. Also see *central office*.

2.2.62 *splash ringing*, *n*—the capability to provide an audible signal simultaneously with trunk seizure on an incoming 9-1-1 call.

2.2.63 *tandem*, *n*—a switching system in the public switched telephone network or a privately owned system that establishes 9-1-1 call routing.

2.2.64 *tandem office*, *n*—the location of the routing table and equipment to direct 9-1-1 calls to the appropriate PSAP.

2.2.65 *TDD/TTY*, *n*—a telecommunication device for the hearing or speech impaired, or both.

2.2.66 *thousands number group*, *n*—the entire last four-digit group of numbers in an exchange, sometimes used to determine default routing locations.

2.2.67 *trunk*, *n*—a circuit connecting switching equipment at two sites (for example, between a PBX and central office, between two central offices).

2.2.68 *trunk group*, *n*—one or more trunks terminated at the same two points.

2.2.69 *trunk seizure*, *n*—the point at which a call is assigned to a trunk and acknowledgement is provided by the 9-1-1 call processing equipment.

2.2.70 *uninterruptible power system (UPS)*, *n*— the capability of providing a continuous source of power without regard to the interruption or loss of commercial power. Also known as *uninterruptible power supply*.

2.3 *Abbreviations:*

2.3.1 *NHTSA*—National Highway Traffic Safety Administration, United States Department of Transportation.

2.3.2 *NTIA*—National Telecommunications and Information Administration, United States Department of Commerce.

2.4 *Acronyms:*

2.4.1 *ACD*—automatic call distributor.
2.4.2 *ALI*—automatic location identification.
2.4.3 *ANI*—automatic number identification.
2.4.4 *CO*—central office.
2.4.5 *CAD*—computer-aided dispatch.
2.4.6 *CPE*—customer premises equipment.
2.4.7 *DMS*—data management system.
2.4.8 *ESN*—emergency service number.
2.4.9 *ESS*—electronic switching system.
2.4.10 *ESZ*—emergency service zone.
2.4.11 *FX*—foreign exchange.
2.4.12 *MSAG*—master street address guide.
2.4.13 *PBX*—private branch exchange.
2.4.14 *PSAP*—public safety answering point.
2.4.15 *PSTN*—public switched telephone network.
2.4.16 *UPS*—uninterruptible power system.

3. Significance and Use

3.1 This guide recommends approaches for planning and developing access to public safety services through the telephone number 9-1-1.

3.2 This guide is of most value when a jurisdiction initiates planning for implementation of a 9-1-1 system or when expansion or consolidation of 9-1-1 systems is contemplated. It may be of particular value to state legislatures considering statewide 9-1-1 legislation.

3.3 This guide will help agencies provide effective response to requests for public safety services initiated through 9-1-1. It should be noted that the public perception of 9-1-1 often includes elements of response systems beyond the scope of this guide. This guide is significant because access to the response system through the public switched telephone network is a critical element of timely and appropriate service delivery.

3.4 This guide has significance for the radio telephone

industries in that consideration should be given to provide compatibility with 9-1-1 enhanced features in both urban and rural areas.

3.5 This guide is not meant to address other response system elements such as public safety dispatching, prearrival instructions, or deployment of field forces.

4. Concept of Operation

4.1 The basic concept of 9-1-1 planning and operation embraces a simple principle: make the system easy to use. In an emergency situation, 9-1-1 allows a caller to contact the appropriate public safety agency and convey information rapidly and efficiently, without placing an unrealistic burden on the caller.

4.1.1 Inherent features of 9-1-1 increase communications efficiency. 9-1-1 is a simple telephone number, easy to remember, easy to dial, and consistently used throughout North America. The missing element is universality in that 9-1-1 is not available in some locations. Most metropolitan areas provide 9-1-1 service, and a handful of states have attained 100 % coverage. While 9-1-1 service is not universally available, the public often has the perception that it is. This may cause problems for persons attempting to use 9-1-1 in areas without 9-1-1 service.

4.1.2 Enhanced features further benefit 9-1-1 users by reducing average call handling time. Automatic number identification displays the caller's telephone number, ALI displays information about the location of that telephone, and selective routing sends the call to the appropriate PSAP for that location. Selective transfer allows rapid redirecting of calls, and alternate routing arrangements assure effective call handling during unusual conditions.

4.2 Performance requirements of 9-1-1 systems are intended to ensure an adequate number of trunks and answering positions available for the population served, the enhancements are accurate and reliable, and all associated equipment performs adequately.

4.2.1 The number of trunks required to provide adequate telephone service for a given population must be determined. To establish a reasonable number of trunks, agencies should provide at a minimum a level or grade of service at P.01. P.01 grade of service simply means that there is an expectation that no more than one call in 100 attempts will be blocked during the average busiest hour.

4.2.1.1 In determining a grade of service for any telecommunications system, the number of calls and the average call duration must be measured. There may be other local considerations that could have a substantial effect on such calculations. See appendix for a sample calculation using representative numbers.

4.2.1.2 A minimum of two trunks per exchange is recommended in all cases.

4.2.2 The method used to determine the number of positions is similar to calculations for the number of trunks, but also includes other call processing requirements.

4.2.3 Other design criteria are also important in planning 9-1-1 systems:

4.2.3.1 9-1-1 trunks should be diversely routed, using different circuit routes wherever feasible.

4.2.3.2 The network provider should ensure current 9-1-1 circuit routing profiles are maintained, circuits are individually tagged to prevent inadvertent disruption, and failure of any circuit element that involves 9-1-1 trunking is automatically detected. Affected PSAPs should be immediately notified of disruptions and corrective action taken in a timely way.

4.2.3.3 Standard call-progress signals should be used to inform the caller of the status of the call.

4.2.3.4 All public telephones, including coin and credit card telephones, shall be configured to allow a caller to dial and complete a 9-1-1 call without inserting a coin or any other device.

4.2.3.5 In order to prevent network disruption remote automatic alarms and automatic dialers should be prohibited by ordinance or law from being programmed to dial 9-1-1.

4.2.3.6 Rural and common carrier radio-telephone users should be able to access 9-1-1. A statewide plan for handling these calls should be developed.

4.2.3.7 Hearing impaired callers shall have equal access to 9-1-1. A statewide plan for handling calls from special population groups should be developed.

4.2.3.8 Non-English speaking callers should have equal access to 9-1-1. A statewide plan for handling calls from non-English speaking population groups should be developed.

4.2.3.9 Calls from all telephones with outgoing access to the public switched telephone network should not be blocked from access to 9-1-1. This includes FX and WATS lines.

4.2.3.10 Calls should enter the 9-1-1 system only after the caller dials all three digits to avoid false calls entering the system.

4.2.4 The ANI should be consistent and reliable from all classes of telephone service, including coin, centrex, PBX, two-party, multi-party, FX, and cellular.

4.2.4.1 The ANI should be transmitted to the PSAP during the call setup sequence so it is immediately available to the PSAP call attendant upon answering the 9-1-1 call.

4.2.5 The ALI should be consistent and reliable from all classes of telephone service, including coin, centrex, PBX, two-party, multi-party, FX, and cellular.

4.2.5.1 The ALI should include the subscriber name for all classes of service as well as the full street address (or functional equivalent in the case of mobile service), additional location information, and community.

4.2.5.2 The ALI display should indicate the correct PSAP and responsible law enforcement, fire, and EMS agencies.

4.2.5.3 Supplementary information regarding the caller location should include area code and number, pilot number, and class of service.

4.2.5.4 Call completion information should include time and date as well as ESN.

4.2.5.5 The ALI system should be maintained at a level sufficient to ensure that the ALI display will be retrieved in less than 5 s for 95 out of 100 attempts during the average busy hour.

4.2.6 Nonselective routing is accomplished through identifying the NXX of the calling party's telephone number or the trunk group associated with that central office.

4.2.6.1 Nonselective routing is appropriate where all the

calls in a central office go to the same PSAP.

4.2.6.2 Nonselective routing can be accomplished either by reading the NXX (and sending the call to the appropriate PSAP by using a routing table), or by assigning each trunk group to a PSAP.

4.2.7 Selective routing should be based on the complete telephone number related to that location rather than just the NXX.

4.2.7.1 Selective routing tables should be updated within 24 h of DMS update.

4.2.8 Transfer capabilities should be consistent and reliable. Transfers between 9-1-1 enhanced PSAPs should include full ANI and ALI capabilities, even if a cross-tandem transfer is involved.

4.2.8.1 Fixed transfer should automatically transfer a 9-1-1 call to the agency associated with a single button as designated by the PSAP. Three-way calling among the 9-1-1 caller, the transferring agency, and the transferred-to agency should be initiated with a single keystroke.

4.2.8.2 Manual transfer should allow transfer of a received 9-1-1 call to a dialed seven-digit or abbreviated number. Three-way calling among the 9-1-1 caller, the transferring agency, and a transferred-to agency should be initiated with the operation of an add-on button (to obtain dial tone) and the dialing of that agency's number.

4.2.8.3 Selective transfer, with the operation of a single button, should automatically transfer a received 9-1-1 call to the action agency as designated by the ESN. Three-way calling among the 9-1-1 caller, the transferring agency, and the transferred-to agency should be enabled by a single keystroke of the button associated with the service required.

4.2.8.4 Release of the call should allow the transferring PSAP to leave the call without disrupting the connection between the 9-1-1 caller and the transferred-to-agency.

4.2.9 Alternate routing allows 9-1-1 calls to be routed to another PSAP or telephone number if conditions warrant.

4.2.9.1 Alternate routing should be automatically executed if all PSAP 9-1-1 trunks are busy.

4.2.9.2 Alternate routing to a predesignated number or another PSAP should be enabled automatically if detectable or, if not detectable by the provider, in less than 5 min of notification to the provider that the equipment at a PSAP is unable to accept 9-1-1 calls.

4.2.9.3 Alternate routing to a predesignated different PSAP should be enabled automatically if detectable or, if not detectable by the provider, in less than 5 min of notification to the provider that an entire PSAP is unable to accept 9-1-1 calls.

4.2.9.4 An automatic alternate routing mechanism should be developed in cases where an individual central office is isolated from the tandem office or both the tandem office and the public switched telephone network.

4.2.10 The PSAP answering equipment should be specially designed for 9-1-1 enhanced call answering.

4.2.10.1 Uninterruptible power systems or some alternate means should be employed to ensure power disruptions will not interrupt calls in progress or prevent new 9-1-1 calls from being received.

4.2.10.2 Splash ringing, or an instant audible signal in the case of automatic call distributors, should be provided to allow calls to be answered as quickly as possible.

4.2.10.3 To manage multiple calls the answering point should have the capability to place calls on hold.

4.2.10.4 Transfer and conference capability should be included in the equipment.

4.2.10.5 The ANI/ALI should be directed to each new position, to each position that picks up a call even if simultaneous pickup occurs, and on transfers to other 9-1-1 equipped PSAPs.

4.2.10.6 Call detail logging should be provided in a format readily adaptable to common commercially sold data base programs.

5. Coordinating 9-1-1 Systems

5.1 Congress has not enacted any legislation specifically funding or coordinating state and local 9-1-1 implementation. Congressional resolutions have been passed supporting the 9-1-1 concept, but it is clear that Congress regards the provision of 9-1-1 service as a state and local matter. What limited Federal funding is available is found in programs such as NHTSA grant funding, community development block grants, and certain other Federal agency programs. The NTIA has also supported the development and distribution of various 9-1-1 planning guides.

5.2 State 9-1-1 statutes are in effect in about three quarters of the states. They aid in resolution of political issues by providing a framework for inter-agency call-handling agreements. They aid in solving technical issues by establishing minimum standards for 9-1-1 implementation and operation. Financial issues are faced by providing a mechanism for funding 9-1-1 implementation and operation, that may involve spreading the costs over a broad population base to make 9-1-1 more affordable in sparsely populated areas.

5.3 Regional agencies, that coordinate planning beyond community, county, or state boundaries, or any combination thereof, have provided a framework for the implementation and administration of 9-1-1 systems in several areas of the country.

5.4 A county government is usually responsible for 9-1-1 system planning, because it is in the best position to secure the cooperation of different agencies and units of government within a reasonably sized area.

5.5 Community-based 9-1-1 systems often provide the starting point for county, regional, and statewide systems.

5.6 Privately operated 9-1-1 systems may be implemented by corporations, educational institutions, or federal facilities. In such circumstances, to ensure compatibility, the planning and development of these systems require that they should be coordinated with adjacent public 9-1-1 systems.

6. State 9-1-1 Statutory Provisions

6.1 Successful implementation of a 9-1-1 enhanced system rests on a clear understanding of the responsibilities of each participating jurisdiction.

6.1.1 While only one jurisdiction may be involved in a 9-1-1 enhanced system, the number of potential jurisdictions and agencies in a system is usually much larger. (In a few

cases, the system may embrace the state and all of its subdivisions.)

6.1.2 If the state is contemplating or has enacted legislation supporting 9-1-1 enhanced system implementation, the responsibilities of the state, its subdivisions, and any privately owned 9-1-1 systems should be set forth explicitly.[2]

6.1.3 The greatest challenge in establishing a multi-user system is to ensure that jurisdictional autonomy in the handling of 9-1-1 calls is not adversely affected by virtue of the jurisdiction's participation in the system.

6.1.3.1 The advantages of the 9-1-1 enhanced system contribute substantially to ensuring that jurisdictional autonomy is preserved, but specific language addressing jurisdictional responsibilities and the responsibilities of privately owned 9-1-1 systems in memoranda of agreement or written protocols is still required.

6.1.3.2 If the state has not enacted legislation in regard to jurisdictional responsibility for 9-1-1 call handling, it is all the more important to ensure that system participants agree on the responsibilities to be assumed in a legally binding way. The responsibilities that should be described and assigned can be divided into management and operational concerns.

6.1.3.3 Among the management concerns are the creation and composition of the system's oversight board or committee; who appoints, who chairs, who may serve, when and where meetings are held; how expenses are met and audited; how a system manager is to be selected, compensated, and supervised; if the board is to be terminated upon system implementation, how termination is effected; and the board's legal authorities (in the employment of consultants, for example).

6.1.3.4 Among the operational concerns are the scope of the system; what specific services are to be included and what 9-1-1 enhanced system capabilities are to be supplied; the planning, design, and implementation of the system; who determines participants; who negotiates with representatives of the public switched telephone network; who evaluates proposals, who may contractually obligate the system and its participants; what legal obligations apply to the handling of calls (from call inception to call acknowledgment); who establishes and promulgates local standards, rules, and regulations, and how they are enforced (including supervision of that portion of the public switched telephone network used in forwarding calls to 9-1-1); who provides and who verifies the data upon which the 9-1-1 enhanced system depends; the financial support of the system (if not provided by state or other law); and the apportionment of expenses (where appropriate).

6.2 State legislation recommending, guiding, or mandating the provision of 9-1-1 service has taken a variety of forms, but all recognize that three system elements must be addressed: the community; the providers of public safety services (usually but not always governmental agencies); and the provider of the telephone network.

6.2.1 A situation of several communities served by different telephone companies and public safety agencies presents the 9-1-1 enhanced system designer with a substantial challenge. Successful implementation will be aided by specific delegation of authority among these groups.

6.2.2 The state legislature should delegate general planning oversight and the development of minimum performance standards to a state agency.

6.2.2.1 The state agency should develop administrative rules to establish standards for consistency in planning and operating 9-1-1 systems throughout the state.

6.2.2.2 A state agency is in a better position than a user group to coordinate and resolve the kinds of multijurisdictional problems that often arise, such as defining service areas or identifying primary response agencies.

6.2.2.3 An agency of the state government may also be more effective in dealing with its utility regulators, who must ensure that the interests of the public are properly balanced with the needs of the telephone network owners. Specific procedures for authorizing expenditures of state or local funds, or both, should be provided.

6.2.2.4 The active participation of a state regulatory commission may be appropriate in the event that telephone service suppliers seek state or local funding to pay for the costs of switching office modifications to accommodate 9-1-1 enhanced services.

6.2.2.5 The state agency should in turn delegate planning authority at the service level to its subdivisions, while retaining right of review and approval based on the state's administrative rules.

6.2.2.6 If a statewide funding mechanism is established to support the 9-1-1 enhanced system, delegation of authority to collect and distribute funds should be provided.

6.3 Implementation problems are best dealt with at the level of execution. Adequate delegation of authority to the overseer of the 9-1-1 enhanced system is critical in order to bring together the disparate system elements. Authority to undertake an area-wide education program, for example, upon the introduction of 9-1-1 enhanced service, should be vested in a system manager.

7. 9-1-1 Funding

7.1 The following are various options for funding a 9-1-1 emergency telephone system:

7.1.1 *General Funds*—Costs are met by line item or other provisions in the tax-supported general operating budgets of the state or participating jurisdictions.

7.1.2 *Service Fee*—Costs are met by a fee or surcharge applied against a specific type of service. In the case of 9-1-1 it is usually applied against local telephone service or long distance service and collected by the local exchange carrier or the inter-exchange carrier and remitted to the funding agency.

7.1.3 *Sales Tax*—Costs are met by a tax applied against goods at the time of sale. This tax may be applied at the local or state level and these funds may be dedicated to planning, implementing, and operating 9-1-1 telephone service.

7.1.4 *Base Telephone Rate*—The 9-1-1 funding requirements are taken into account in determining tariff rates for local telephone service.

[2] "Suggested State Legislation," Vol 40, Council of State Governments, P.O. Box 11910, Lexington, KY 40578.

7.2 The following are specific factors that must be considered in establishing funding for 9-1-1 telephone service:

7.2.1 *Personnel*—The number of personnel required to plan and administer a 9-1-1 system will vary with system design, area of coverage, and responsibilities. The following are specific functions for which staffing is necessary:

7.2.1.1 Oversight/management of planning, implementation, and operation of the 9-1-1 telephone system,

7.2.1.2 Responsibility for the development, accuracy, and maintenance of the MSAG and 9-1-1 data base,

7.2.1.3 Development of regular and special public education campaigns and related materials, and

7.2.1.4 Development of a training program for PSAP call attendants and supervisors in the use and operation of the 9-1-1 telephone system.

7.2.2 *Telephone Service*—The major expense is for telephone service implementation. Some of the cost components are nonrecurring and funding responsibility may be negotiated in some cases. These components include the costs of modifying the telephone network to provide 9-1-1 service, such as costs of trunking, central office modifications, software upgrades, and other network considerations.

7.2.3 *Construction*—Costs of building, redesigning, or upgrading the PSAP facility so as to allow for the installation of the 9-1-1 customer premises equipment.

7.2.4 *Customer Premises Equipment (CPE)*— Costs of equipment needed at the PSAP to provide and operate the 9-1-1 telephone system. This includes ANI and ALI controllers, display terminals, telephone sets, recorders, printers, generators, UPS, and other equipment.

7.3 The following costs will recur over the life of the system:

7.3.1 Monthly billed costs for the operation and maintenance of the 9-1-1 system,

7.3.2 Charges for equipment maintenance and replacement or upgrade that will occur due to changes in technology, and

7.3.3 Costs that are incurred monthly for administration and operation, such as payroll, insurance, utilities, other telephone service, office equipment and supplies, and other operating expenses.

8. Geographical Data Bases

8.1 The development and maintenance of an accurate ALI data base is critical to enhanced 9-1-1 success, and may involve other community resources.

8.1.1 The ALI data base is located in the 9-1-1 computer, that contains the information to be displayed at the PSAP attendant position when a 9-1-1 call is received. This computer is typically located at the serving telephone company's facilities, but could be located at other nearby or remote sites.

8.1.2 The following ALI features are required:

8.1.2.1 The ALI file will be accessed from the PSAP when ANI data associated with the call is identified.

8.1.2.2 The ALI displays the name and address associated with the calling telephone number once the PSAP receives the 9-1-1 call.

8.1.2.3 The ALI identifies the time and date the ALI information is requested by or retrieved at the PSAP.

8.1.2.4 The ALI provides display of additional information related to the telephone number and address from which the 9-1-1 call originated.

8.1.2.5 The ALI identifies the type or class of telephone service, that is, coin phone, residence, business, business extension, FX, and TDD.

8.1.2.6 The ALI identifies the ESN (emergency service number) of the location, that in turn identifies law enforcement, fire, and EMS responders for the calling address.

8.1.3 The ALI data is retained and redisplayed when a call placed on hold is retrieved by a PSAP call attendant.

8.1.3.1 An address that does not have telephone service will not have a file in the ALI data base.

8.1.3.2 Updating of the telephone number specific records contained in the ALI data base should be done on a daily basis to maintain current information.

8.2 The 9-1-1 enhanced systems require a reliable addressing system throughout the areas covered. A state agency should take the lead in establishing an address program, or a county should establish an address program in conjunction with 9-1-1 enhanced implementation.

8.2.1 A statewide address program requires cooperative agreements among local government entities and political subdivisions to establish formal participation in an addressing project involving multiple governmental entities.

8.2.2 An address program at a level below a statewide program also requires many cooperative agreements and coordination requirements. Building a successful address program regardless of level involves the following considerations:

8.2.2.1 Developing organizational responsibilities and the staffing for assigning addresses.

8.2.2.2 Implementing an addressing project. This can range from six months to several years of planning and address mapping tasks.

8.2.2.3 The cost of a uniform address program will depend on number of properties to be addressed and the data base needs.

8.2.2.4 Critical system tools required include maps and specific procedures for locating parcels and structures.

8.2.2.5 Address ranges should be assigned to streets based on a predetermined addressing grid applied to the map.

8.2.3 Address assignment should include a system of record keeping and maintenance.

8.2.3.1 Notification to the affected specific residents or businesses is necessary for new addresses. Cooperation between the post office and the agency responsible for addressing is recommended.

8.2.3.2 Once new addresses are assigned, the responsibility for maintenance should be assigned to an appropriate body.

8.2.4 Posted street signs and house numbers are necessary for locating structures. Specifications should include size, material, longevity, and legibility. These requirements should be delineated in local or state addressing ordinances.

8.2.5 Telephone company standards and U.S. Postal Service guidelines should be considered when implementing a uniform addressing program.

8.2.5.1 The sequence of address elements should be as follows: street number, pre-directional, primary street name, designator, post directional, and secondary number if any. The

sequence may vary depending on telephone company service order writing standards.

8.2.5.2 Specific addresses should be used and nonspecific addresses, for example an intersection or PO Box, should be avoided.

8.2.5.3 Addressing continuity should be maintained throughout a community and, where possible, throughout a county.

8.2.5.4 Each street should have only one correct name. The use of directionals or designators to distinguish separate, noncontiguous streets should be avoided wherever possible (that is, Palm Court, Palm Avenue, Palm Street).

8.2.5.5 There should be no primary street names that are also used as designators or directionals (that is, Court Street or Southeast Blvd.).

8.2.5.6 There should be no sound alike street names (that is, Beach, Beech).

8.2.5.7 Street names should not be longer than fifteen (15) characters.

8.2.5.8 Special characters in street names (that is, hyphens, apostrophes, periods, decimals) should be avoided.

8.2.5.9 Official street numbers should proceed from a logical point of origin and should be in numerical sequence in relation to other lots with frontage on the same street.

8.2.5.10 Odd numbers should be assigned to properties on one street side and even numbers should be assigned to properties on the other side. Numbers should provide flexibility to accommodate additional development.

8.2.5.11 There should be no primary street numbers longer than six numerals.

8.2.5.12 There should be no fractions in the addresses.

8.2.5.13 Alphanumeric primary or secondary address numbers should be prohibited.

8.2.5.14 Multi-unit structures should be addressed with primary numbers and with apartment or suite numbers as secondary location indicators.

8.2.5.15 Streets within multi-structure complexes should be named and each structure individually addressed.

8.2.5.16 Streets within mobile home parks should be named and each lot should be individually addressed.

8.3 Selective routing is directed by selective routing tables that are defined by local jurisdictions.

8.3.1 The selective routing file resides in the 9-1-1 tandem.

8.3.2 Selective routing tables are developed by the telephone company. They consist of all telephone numbers and ESNs for telephone subscribers within boundaries of the 9-1-1 system and are programmed into the tandem for call routing. The tandem uses the ESN to identify and route the call.

8.3.3 The tandem uses the ANI from each call to retrieve the routing information and forward the 9-1-1 call to the appropriate PSAP.

8.3.4 If transfer to a secondary PSAP is required, the tandem, or a privately owned switch, also performs the transfer and selective transfer functions.

8.4 Service areas with specific combinations of responders for law enforcement, fire, and EMS are defined by local jurisdictions.

8.4.1 The ESN's in the 9-1-1 data base identify these combinations to the tandem for routing of the 9-1-1 call to the appropriate PSAP.

8.4.2 Each ESN corresponds to a set of law enforcement, fire, and EMS responders to be displayed on ALI at the PSAP.

9. Other Planning Concerns

9.1 Initial plans for public education should include an explanation of 9-1-1 service, noting the agencies and the area to be served.

9.1.1 All sectors of the public should be included, from preschool through senior citizens.

9.1.2 Prior to cutover a publicity plan should be formulated. This plan includes provisions for preparation, productions, and dissemination of materials involving various media such as brochures, audio visuals, billboards, public speaking engagements, press packets, novelty items, and children's items. The plan should also include an implementation schedule.

9.1.3 A plan for continuing public education should also be developed. This plan includes periodic release of performance statistics and other information regarding changes in the system, and means to gather and release information about significant actions resulting from 9-1-1 use.

9.2 The jurisdiction responsible for training should determine initial and ongoing training requirements and ensure that they are met.

9.2.1 Introductory training of 9-1-1 personnel in system operation should be provided.

9.2.2 Periodic refresher training is necessary to maintain an efficient system.

9.3 In order to maintain the system at an optimum operational level, a standard operating procedure should be developed by representatives of the agencies served in the system.

9.3.1 The system manager should be responsible for supervision of the system operation, equipment maintenance, data base accuracy, and continued refinement of thestandard operating procedures.

9.3.2 The system manager should be knowledgeable about developments and changes in 9-1-1 system technology and procedures, and should undertake to accomplish changes and enhancements that will benefit the 9-1-1 system. The manager should actively participate in public safety and communications conferences and seminars.

9.4 The CAD interface compatibility should be included in PSAPs which use or plan to install computer aided dispatch.

9.5 The many applications of technology to personal communications and other mobile telephone services are important to 9-1-1 planners. Such developments broaden the base of potential sources of 9-1-1 calls as well as the means used to access 9-1-1 service. The pace of technological development suggests that failure to recognize and accommodate such development may adversely affect the coordination and provision of effective 9-1-1 enhanced service.

9.5.1 For example, personal communications networks using mobile satellite technology are likely to proliferate if spectrum allocations can be gained. Political boundaries in consideration of network service areas are essentially meaningless. If a caller can access the PSTN and dial 9-1-1 special treatment is required. Similarly, "intelligent vehicle/highway systems" are being developed that transmit operational data

that could include a sensory alarm of an accident. The translation of such signals into an acceptable format for 9-1-1 processing will require careful planning.

9.5.2 The use of "800" service may generate potential problems for 9-1-1 service providers. A crisis intervention center, for example, may advertise widely its "800" number through which its services may be obtained. The situation described by a caller may prompt crisis center personnel to place a call into the 9-1-1 system in the locality of the crisis center. Obviously, if the call is received on a 9-1-1 trunk, the ALI data displayed at the PSAP are meaningless. While 800 numbers may be programmed to generate 9-1-1 enhanced data, that information would be of little value in cases such as this. Such unusual conditions must be recognized by the 9-1-1 planner or system manager.

9.6 Some jurisdictions may opt to install a 9-1-1 enhanced system in which all features, except ANI, are locally provided and maintained. The requirements in this guide are equally applicable to these systems.

9.7 A man-made or natural disaster may produce various kinds of unanticipated malfunctions in a 9-1-1 system. Potential problems should be identified by continually testing the system under stress conditions, that could include simultaneous test calls by public safety personnel throughout the area served. Other disaster planning should be coordinated with state, local, and telephone company emergency preparedness planners to ensure that the needs of the 9-1-1 system are adequately addressed in such circumstances, including the provisioning and restoration of the PSTN.

10. Keywords

10.1 automatic location identification (ALI); automatic number identification (ANI); basic 9-1-1; emergency medical services (EMS); emergency service number (ESN); enhanced 9-1-1; fire; law enforcement; master street address guide (MSAG); 9-1-1; public safety; public safety answering point (PSAP); selective routing; tandem

APPENDIX

(Nonmandatory Information)

X1. GRADE OF SERVICE CALCULATIONS

X1.1 The best way to determine the number of lines needed in a communications system is to measure actual usage on existing lines over an extended period of time and at different hours of the day, adjusting the figures to account for such variables as the number of calls that will still be answered on the seven-digit numbered lines, the decrease in the length of the average call due to 9-1-1 feature-induced faster call handling, and the specimen in duplicate calls due to ease of dialing 9-1-1. This in-depth analysis requires special skills, is time consuming and expensive. Reasonable estimates are usually sufficient for the initial design of 9-1-1 systems. Estimates can be developed by using assumed or measured demographic and calling characteristics of the population to be served to calculate the amount of line loading, then referring to a distribution table, typically a Poisson table, to determine the number of lines that would handle that load at the desired grade of service. Poisson tables are based on call blockage on the first attempt. Other distribution tables, generally available through telephone traffic engineers, may be more accurate than Poisson tables since they account for unusual traffic patterns such as peakedness, fast retries of blocked calls, or all calls overflowing to another PSAP or another telephone number. Generally speaking, however, Poisson tables are sufficiently accurate to provide a good estimate of the number of lines needed.

X1.2 The following example contains assumptions based on the operational experience of 9-1-1 systems, but local jurisdictional requirements should be considered when using these calculations:

X1.2.1 There are 1.5 to 3.0 people per telephone main station.

X1.2.2 The length of the average 9-1-1 call is 90 s, measured from time of trunk seizure to the time of call termination. (Ninety seconds is allowed to provide for differences in technology, training, and operations. No special call handling techniques, such as pre-arrival instructions, hostage negotiations or other extenuating circumstances, have been considered in this calculation.)

X1.2.3 An estimated 10 % of the calls on the busiest day of the average week will be placed during a 1–h period.

X1.2.4 One 9-1-1 call per thousand people per day can be expected in a rural area.

X1.2.5 Two calls per thousand people per day can be expected in an area with over 25 000 population or within five miles of such an area.

X1.2.6 Three calls per thousand people per day can be expected in an area with over 100 000 population or within ten miles of such an area.

X1.3 The degree of loading on a network is generally measured in CCS (hundred call seconds). CCS can be determined by using the following calculation:

$$CCS = \frac{population \times 90 \times 0.1 \times CPT}{100 \times 1000}$$

or:

$$CCS = \frac{MS \times 2.8 \times 90 \times 0.1 \times CPT}{100 \times 1000}$$

where:
MS = telephone main stations,

2.8 = conversion to number of people,
90 = seconds of hold time,
0.1 = conversion to hours (10 % of daily calls), and
CPT = calls per thousand people per day.

X1.3.1 By that formula (and using a Poisson table for trunkage):

over 1600 lines (4400 people); two trunks (0.4 CCS)
over 10 700 lines (30 000 people); three trunks (5.4 CCS)
over 31 000 lines (87 000 people); four trunks (15.7 CCS)
over 39 000 lines (110 000 people); five trunks (29.6 CCS)
over 61 000 lines (171 000 people); six trunks (46.1 CCS)
over 85 000 lines (240 000 people); seven trunks (64.4 CCS)
over 111 000 lines (310 000 people); eight trunks (83.9 CCS)
over 139 000 lines (390 000 people); nine trunks (105 CCS)

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(**10**) Ehrlich, Roanne R., "A Study of Relationships During the Establishment of an Enhanced 911 System," Mankato State University, Mankato, MN, January 1984.
(**11**) "Suggested State Legislation," Volume 40, Council of State Governments, PO Box 11910, Lexington, KY 40578, 1981.

[3] These documents (and many others related to 9-1-1) are available through Associated Public Safety Communications Officers, Inc., APCO-IS, New Smyrna Beach, FL 32170.