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Network Quality Assurance

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1 Executive Overview

1.1 Purpose and Scope of Document

Single points of failure in the 9-1-1 network should not be tolerated. Network and Emergency Services providers should design and deploy fault tolerant systems which will eliminate, as much as possible, single points of failure that prevent routing 9-1-1 calls successfully.

The solution should be capable of delivering a 9-1-1 call to a designated default Public Safety Answering Point (PSAP) during times of network failure through either alternate routing, Emergency Stand Alone (ESA) / Emergency Transport Backup (ETB) / Emergency Line Access (ELA) capabilities, cellular networks, etc. and should be automated when/where possible.

Very clearly, the first priority is to route the call to a designated PSAP. It is understood that during an isolation of the remote switch or another failure of the network, features such as Automatic Number Identification (ANI) and Automatic Location Identification (ALI) may not be provided.

This document provides NENA's recommendations to accomplish those goals. Adoption of these practices should immediately be considered by all entities involved in providing 9-1-1 service.

1.2 Reason to Implement

This document provides NENA's recommendations to accomplish the above purpose. Adoption of these practices should immediately be considered by all entities involved in providing 9-1-1 service.

1.3 Benefits

This document provides recommendations which can be a resource for technicians, administrators and managers who are charged with maintaining quality assurance over the network and help them better manage network performance.

1.4 Document Terminology

The terminology used in this document has been aligned to designate definitions used within the American National Standards Institute standard for Telecommunications technical standard T1.628-2000 Emergency Calling Service, issued by the Alliance for Telecommunications Industry Solutions (ATIS).

1.5 Reason for Issue

With the advent of electronic switching in the 1960's and 1970's, telephone companies began using remote central office equipment in an effort to save capital dollars in a single location as the new architecture made this practice technically feasible. Because the cost of this practice was considerably less than that of deploying a stand-alone central office, the practice became and remains extremely popular.

Because the remote depends on the intelligence of the host for Automatic Number Identification (ANI) billing and connection to the "outside world," if disconnected from the host switch the remote would be unable to operate on its own. In addition to not being able to route calls, the remote would also not be able to forward emergency 9-1-1 calls to a PSAP. Even with the deployment of Emergency Stand Alone (ESA), the risk remains that unless the PSAP is located within the jurisdictional boundaries of the remote switch or that Emergency Transport Backup (ETB) / Emergency Line Access (ELA) (e.g., wireline or wireless based) or equivalent is provided where facilities are available, no 9-1-1 service will be available. Where multiple remotes are co-located, a distinct ETB / ELA (carrying a separate Directory Number) shall be required for each remote.

1.6 Reason for Reissue

NENA reserves the right to modify this document. Whenever it is reissued, the reason(s) will be provided in this paragraph.

This document, first published in 1995, is being reissued as a NENA Technical Information Document (TID). It is being reissued because, during recent years, all levels of government, NENA, and the public safety community have become concerned as more rural areas were served by remote switching or a single host switch serving a larger territory. This, coupled with the fact that failures to 9-1-1 systems were becoming more common, prompted the formation of the Network Reliability and Interoperability Council's E9-1-1 Focus Group in order to explore 9-1-1 failures, determine possible impacts, and offer suggestions for solutions.

In addition to the concerns raised with the host – remote network architecture and Next Generation Network (NGN) networks, competition in the local telecommunications market has resulted in a proliferation of digital switching equipment throughout North America. The Federal Telecommunications Act of 1996 rewrote the original Telecommunications Act of 1934 to open up competition in the local exchange markets. The 1996 Act essentially requires all local exchange carriers (LEC) to allow interconnection into their networks and the LECs must not deploy network features or functions that interfere with interoperability.

Opening local exchange markets to competition has impacted the embedded 9-1-1 network architecture that was in place prior to the Act. The Competitive Local Exchange Carrier (CLEC) is required to provide the same level of 9-1-1 service to their end users as those users had prior to changing service providers. With advancements in digital switching technology, a single central office of a CLEC can serve multiple geographic areas that are traditionally served by several end offices of the Incumbent Local Exchange Carrier (ILEC). With multiple CLECs serving potentially the same geographic market areas, the probability exists for an increase in the number of single points of failure.

In the wake of opening local markets for competition, numbering resources have been severely depleted. Measures such as NPA Splits and Overlays, Telephone Number Portability (TNP), Local Number Pooling, and Rate Center Consolidation have been used to conserve the numbering resources that remain. Each has its own unique impact to 9-1-1, but collectively these measures have resulted in the necessity to gradually change end office trunks from MF signaling to SS7 signaling.

Thus, concerns with respect to the reliability of the out-of-band SS7 network architecture are raised in the context of 9-1-1 call delivery.

1.7 Date Compliance

All systems that are associated with the 9-1-1 process shall be designed and engineered to ensure that no detrimental, or other noticeable impact of any kind, will occur as a result of a date/time change up to 30 years subsequent to the manufacture of the system. This shall include embedded application, computer based or any other type application.

To ensure true compliance the manufacturer shall upon request provide verifiable test results to an industry acceptable test plan such as Telcordia GR-2945 or equivalent.

1.8 Cost Factors

The recommendations and alternatives discussed herein are subject to cost-benefit analyses. Some may be cost neutral (diversification) while others may be quite costly to implement.

1.9 Cost Recovery Considerations

Normal business practices shall be assumed to be the cost recovery mechanism.

1.10 Acronyms/Abbreviations

This is not a glossary! See NENA 01-002 - NENA Master Glossary of 9-1-1 Terminology located on the NENA web site (NENA Master Glossary Standard of 9-1-1 Terminology) for a complete listing of terms used in NENA documents.

The following Acronyms are used in this document:	
ALI	Automatic Location Identification
ANI	Automatic Number Identification
ATIS	Alliance for Telecommunications Industry Solutions
CCS	Common Channel Signaling
CLEC	Competitive Local Exchange Carrier
DRP	Disaster Recovery Plan
ECOM	Essential Communications During Emergencies
ESA	Emergency Stand Alone
ETB	Emergency Transport Backup
ELA	Emergency Line Access
FCC	Federal Communications Commission
ILEC / LEC	Incumbent / Local Exchange Carrier
ISDN	Integrated Services Digital Network
TNP	Telephone Number Portability
NRC	Network Reliability Council
NRIC	Network Reliability and Interoperability Council
PBX	Private Branch Exchange

The following Acronyms are used in this document:	
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network

2 Network Reliability and Interoperability Council (NRIC)

2.1 Overview

In 1992, the Federal Communications Commission (FCC) chartered the Network Reliability Council (NRC) to assess the reliability of the North American telecommunications network and to recommend measures to improve its reliability. In April 1996, the FCC changed the name of the NRC to the Network Reliability and Interoperability Council (NRIC). For simplicity, the council will be referred to as the NRIC in the following discussion.

Given the critical connection between network reliability and emergency service access represented by 9-1-1 networks/systems, the First Council (1992) selected 9-1-1 networks as one of its seven initial focus areas (see http://www.nric.org/index.html). The E9-1-1 focus group, Focus Group 4, conducted a comprehensive review of 9-1-1 service delivery and studied the connection between its reliability, telecommunications industry practices and network architecture (see http://www.nric.org/pubs/nric2/fg4/index.html). Data was compiled and analyzed on outages of 9-1-1 systems across the United States. The group interviewed experts from the local exchange industry and, more importantly, operators and managers of 9-1-1 systems. The NRIC also reviewed the performance of 9-1-1 networks/systems in heavy load conditions that are far beyond the scope of design specifications.

Initially, the performance data used in the study were collected from 18 Local Exchange Companies (LECs) ranging in size from Southern New England Telephone Company to GTE. Additional data were gathered from 9,941 central offices and from management personnel in 1,394 PSAPs.

The categories of failures were identified as (non-exhaustive list):

- LEC End Office
- LEC Tandem Office (now E9-1-1 Control Office)
- Interoffice Facility
- PSAP/9-1-1 Equipment
- Other

The categories for causes of failures were identified as:

- Hardware
- Software
- Traffic Congestion/Overload
- Cable Error
- Craft Error

- Other
- Unknown

2.2 Findings

Based on the analysis of the data collected, the E9-1-1 Focus Group reached the following conclusions:

- Network design and architecture supporting 9-1-1 service is increasingly concentrated with identifiable potential single points of failure. The result is an increasing risk for large 9-1-1 disruptions if outages appear in the network generally or in 9-1-1 facilities particularly. At the same time, some new and existing network features provide opportunities to increase the reliability if employed in the provisioning of 9-1-1.

- There is a need for improved communication among the LECs providing 9-1-1 service and emergency service providers.

- There were 123 outages to 9-1-1 systems in 1991-1992. A review of these outages revealed that over half of the disruptions were caused by a failure of the interoffice facility transporting the 9-1-1 call.

- A survey of 9-1-1 system administrators revealed that they were generally pleased with the level of 9-1-1 service delivery they were experiencing.

- There are other important 9-1-1 related reliability issues which were outside the scope of the study, including cellular and PBX based calls, PSAP equipment maintenance, and ALI database accuracy.

2.3 Recommendations

The NRC's Focus Group IV (Essential Communications During Emergencies (ECOM) Team) made the following recommendations known as "Essential Services Best Practices" (please see http://www.bell-labs.com/cgi-user/krauscher/action.pl?Submit=Submit&essential_services=1) which NENA strongly supports. The team indicated in their report that they believe that implementation of these practices will improve the reliability of the Public Switched Telephone Network (PSTN) and minimize the potential for interruption of vital emergency communications.

- LECs should move to eliminate single points of failure in the interoffice facilities, serving E9-1-1 Control Office switches, and ALI database portions of the 9-1-1 network, beginning with the least costly measures. These measures include exploiting existing opportunities for physical route diversity and special handling of 9-1-1 serving arrangements. This recommendation does not extend to the local loop between any subscriber and the end office, which provides dial tone.

- LECs should carefully evaluate and consider reversing the trend toward concentrating 9-1-1 network elements. Examples of such concentration include large numbers of PSAPs in single E9-1-1 Control Offices and the use of high capacity network concentrators such as digital cross connect systems without an appropriate diverse routing architecture.

- The ECOM Team considers all of the Best Practices formerly defined by the earlier NRIC effort to still be valid with the exception of the recommendation to avoid use of the Common Channel Signaling (CCS) network for 9-1-1 services. The CCS network has demonstrated reliability for non-emergency applications and may now be considered as a viable alternative for emergency network routing applications (i.e., Best Practice ES27 – Common Channel Signaling). Further, telecommunication standards bodies have created SS7-compatible data packets for passing caller location and other wireless information detail to Integrated Services Digital Network (ISDN) PSAPs.

- LECs, wireless carriers, 9-1-1 administrators, and public safety agencies should improve communications among themselves. A formal communications mechanism should be established to develop, review, and update disaster recovery plans for 9-1-1 service. The forum should be open to all stakeholders of 9-1-1 service. Emerging issues such as cellular-based 9-1-1 calls and PBX/9-1-1 call handling would be appropriate agenda items.

- The 9-1-1 Focus team recommended the use of FCC outage reports (Docket 91-273) as the standard metric by which national 9-1-1 reliability improvements should be tracked. Criteria and rules for reporting 9-1-1 outages can be viewed at the FCC web site, Chapter I – Federal Communications Commission (FCC), Part 63, Rules in Sec 63.100 "Notification of Service Outage" at the Network Outage Reports page (http://www.fcc.gov/oet/outage/).

3 Alternate/Diverse Routing

As indicated in the NRC's Emergency Services Best Practices, NENA strongly recommends the use of alternate or diverse routing and diverse facilities in order to avoid single points of failure. These facilities would include but are not limited to carrier, cable, fiber (ring topology), trunk bay, fusing and power feed to help ensure fault tolerance. Where diverse facilities exist they should be used.

According to the NENA Master Glossary Standard of 9-1-1 Terminology, diverse routing is defined as the practice of routing circuits along different physical paths (diverse facilities) in order to prevent total loss of 9-1-1 service in the event of a facility failure. The concept of diverse facilities is integral to diverse routing.

Diverse facilities provide at least two physical circuits to transport network traffic and are characterized by separate cable sheaths and outside plant structures. The facilities should be physically separated (diverse routing) so that the failure of any single network element cannot interrupt E9-1-1 service to all trunks in a group.

3.1 E9-1-1 Circuits

The circuits in the E9-1-1 system are a combination of switched message trunks and private line data circuits. Provided below is a description of some circuit types:

- Serving End Office to E9-1-1 Control Office Switched Message Trunks -
  Provide communications paths for traffic from the end office serving the 9-1-1 caller to the E9-1-1 Control Office.

- E9-1-1 Control Office to PSAP Switched Private Line/Trunk Circuits - Provide analog/digital communications paths for traffic from the E9-1-1 Control Office to the PSAP.

- PSAP to ALI Host Private Line Data Circuits or Switched Data Circuits -
  Provide data communications paths between the PSAP and the ALI host for Automatic Location Identification (ALI) information requests and/or ALI data delivery.

- E9-1-1 Control Office to the E9-1-1 database Private Line Data Circuits

- Other critical data circuits are required to link various critical 9-1-1 data components / adjunct systems (Database Management System (DBMS), Emergency Service Control Point (ESCP), etc.) to each other

These dedicated E9-1-1 trunks and private line circuits are to be assigned to route diverse facilities so that the failure of any single Network element cannot interrupt E9-1-1 service to all trunks in a group. This concept applies to all E9-1-1 Control Offices, including mirrored control offices.

3.2 E9-1-1 Network Diversity

When discussing diversity in a network, two concepts must be considered – diverse routing and diverse facilities (or transport). Diverse routing implies diverse facilities but the opposite may not be true. Both must be implemented to completely eliminate single points of failure.

Diverse routing is highly recommended and may be required per local statutes for all circuits associated with the E9-1-1 system. Requirements for each circuit type are provided below:

- Serving End Office to E9-1-1 Control Office Switched Message Trunks must be route diverse. There should be at least two trunks from each central office to the E9-1-1 Control Office. A pair of diverse circuits may be assigned on a fiber ring system or a fiber system with diversely routed protection. These circuits do not need to be assigned to different DS3s.

- E9-1-1 Control Office to PSAP Switched Private Line Circuits should be route diverse from the E9-1-1 Control Office to the serving wire center of the PSAP where available (the local loop between the PSAP and its serving end office is still vulnerable to single point failures, but this shortcoming can be overcome using sheath diversity, route diversity, etc). One circuit from the

PSAP to each ALI host computer is required. A pair of diverse circuits may be assigned on a fiber ring system or a fiber system with diversely routed protection. These circuits do not need to be assigned to different DS3s.

- PSAP to ALI host Private Line or Switched Data Circuits should be route diverse from the serving wire center of the PSAP location to the ALI host computer locations where available. Where each PSAP is connected to two different ALI host computers for diversity and redundancy, the pair of diverse circuits may be assigned on a fiber ring system or a fiber system with diversely routed protection. These circuits do not need to be assigned to different DS3s. If dual-switched packet data circuits are used, host diversity and call redirection should be provided.

- E9-1-1 Control Office to the E9-1-1 database Private Line Data Circuits should be route diverse from the E9-1-1 Control Office to the ALI host computer locations where available. Each E9-1-1 Control Office is connected to two different ALI host computers located in different locations for diversity and redundancy. The pair of diverse circuits may be assigned on a fiber ring system or a fiber system with diversely routed protection. However, these circuits do not need to be assigned to different DS3s. If dual switched packet data circuits are used, host diversity and call redirection should be provided.

(NOTE: CALL-REDIRECTION means the "switched data" NETWORK software that allows "switched data" calls to be re-routed to an alternate switched data circuit in case of primary switched data circuit failure.)

It is important to note that when planning routes for mirrored control offices, each member of the mirrored pair MUST be viewed as if it were not in a pair. This means that, where facilities exist, route diversity is recommended for each E9-1-1 control office.

4 Fiber Rings

Fiber optic network elements are providing the opportunity to aggregate large amounts of traffic into one transport facility. This traffic aggregation is in opposition to the transport diversity as described in best practices. An important network topology available with the new fiber optic terminals is fiber rings. A fiber ring is a collection of nodes forming a closed loop whereby each node is connected to two adjacent nodes via a duplex communications facility. A ring provides redundancy so services can be automatically restored following a failure or degradation in the network. Rings are usually described as being "self healing" architectures.

5 Minimum Trunking Requirements

The quantity of 9-1-1 trunks should be discussed fully by the service provider and the public safety entity. It is recommended that E9-1-1 trunking be designed at a minimum of P.01 grade of service. The probability (P), expressed as a decimal fraction, of a telephone call being blocked. P.01 is the grade of service reflecting the probability that one call out of one hundred during the average busy hour will be blocked. P.01 is the minimum recommended Grade of Service for 9-1-1 trunk groups.

For existing systems this should be based on measured traffic. For a full discussion of minimum trunking requirements and how to determine them, please see NENA 9-1-1 Voice Circuit Standard. For an example of how these recommendations could be implemented, please see the State of Pennsylvania's Technical Standards for Plans.

6 Host - Remote Considerations

It is strongly recommended that network service providers accept the responsibility of designing a network that ensures 9-1-1 call delivery under all but the most severe conditions. Emergency service providers should accept the responsibility of providing service requirements to the network service provider. Equipment, systems and service providers should accept the responsibility of building cost effective solutions that match the needs of the network service provider and the emergency service provider.

With the wide range of solutions available on the market, there is no reason to deploy a new remote without a 9-1-1 network survivability feature solution installed. Ideally, any changes to the network configurations warrant a check to ensure E9-1-1 still functions. The primary objective will be call delivery, with ANI and ALI as secondary objectives. The goal is to assure that if a subscriber can make any telephone call, the subscriber is able to dial the digits 9-1-1.

6.1 Remote Switch Isolation

There are differences in how various switches function when connectivity between remote switch modules and host switches is lost. The following chart presents suggestions for consideration in processing 9-1-1 calls during isolations of remote switches from their host. They are presented in order of preference, with the least desirable treatment being where a 9-1-1 caller hears ringing when their call is not actually connected to a 9-1-1 PSAP.

CONDITION	TREATMENT	REMARKS
End users do not receive dial tone.	No treatment	No treatment option available as calls are not possible.
End users have dial tone and remote has emergency service alternate route capability.	Obtain a 7 or 10-digit emergency number that works out of the remote from authorized public safety agency and program into remote for automatic re-route purposes.	During a switch isolation, when 9-1-1 is dialed, the call is forwarded automatically to the alternate number.
End users have dial tone and remote has emergency service alternate route capability, but there is no public safety agency that has a number that works out of the remote.	Route 9-1-1 calls to a foreign exchange line connected to a remote host switch or a line connected to a wireless dial-backup device that uses a wireless transceiver to establish a link to a public safety answering point.	This is invoked automatically and only requires longer call setup on the first re-routed 9-1-1 call.
End users have dial tone and remote has emergency service alternate route capability, but there is no public safety agency that has a number that works out of the remote.	Route 9-1-1 calls to a line connected to a KNOX-BOX® Rapid Entry System type device mounted on the outside of the structure where the remote is housed.	Steps should be taken to ensure that calls do not ring into a Ring – No Answer condition until personnel arrive to take the calls. This can be accomplished by using toggle switches to busy out lines or using other MKBUSY applications
End users have dial tone and remote has emergency service alternate route capability, but there is no public safety agency that has a number that works out of the remote.	Route 9-1-1 calls to recorded announcement.	For remotes that lack recorded announcement capability, consider using a line connected to a digital answering machine co-located with the remote with appropriate “announce only” message.
End users have dial tone but remote has no emergency service alternate route capability.	Route 9-1-1 calls to re-order treatment.	A “fast busy” is much preferred over returning audible ring.

6.2 Recommended Standards

In order to move forward with implementation, it is strongly recommended that the network service provider and emergency service provider deploy or upgrade systems to meet the following recommended standards:

- All new installations of remotes will be able to route 9-1-1 traffic when the remote is isolated from the host (survivability feature). It is recognized that there may not always be somewhere to route 9-1-1 calls within the remote served area, and it may be difficult to find a route that is diverse from the umbilical serving the remote. Vendors and emergency agencies must seek solutions for each unique situation. In no case should the call go to "ring, no answer."

- The network service provider should upgrade the current installations to route 9-1-1 traffic during isolation.

- Emergency service providers and network service providers should plan for and design solutions that will ensure 9-1-1 callers are not isolated from emergency services during network problems. The switch over to alternate routing and return to normal service should be as automated as possible.

- Equipment, systems, and service providers should offer products which match the needs and requirements of the emergency service provider with the architecture of the installed network to maintain 9-1-1 service assurance

6.3 Monitoring the Network

NENA strongly recommends that all E9-1-1 networks be monitored for proper service levels and to allow proactive steps in the event of a failure. Procedures should be developed and implemented to monitor all voice and data circuits that support 9-1-1 call processing. E9-1-1 service providers shall establish procedures that are used to take failed circuits out of service so that calls use live (generally diverse) E9-1-1 circuits or facilities which might be available. The service provider is expected to repair and restore circuits to full capacity as quickly as possible. These circuits include but are not limited to:

- Point of origin of 9-1-1 call to E9-1-1 Control Office
- Transport Facilities supporting E9-1-1 processing
- E9-1-1 Control Office
- E9-1-1 Control Office to Primary and Secondary PSAPs
- E9-1-1 Control Office to ALI computer(s)
- Primary and Secondary PSAPs
- PSAPs to ALI computer(s)

Circuits that support 9-1-1 data processing should also be monitored. These include but are not limited to:

- Data Management System to E9-1-1 Control Office
- Data Management System to ALI computer(s)

Technology is available to monitor all segments listed above.

7 Disaster Recovery

7.1 Disaster Recovery Plan

NENA recommends that all E9-1-1 systems have Disaster Recovery Plans (DRP) in place prior to the time they cut "live to the public." For all systems that are already live but either do not have a DRP or have an obsolete DRP, it is recommended that each PSAP and E9-1-1 Service Provider have a current DRP for their respective areas. It is further recommended that all DRPs for E9-1-1 systems be reviewed and optimized annually.

The Disaster Recovery Plan should be established, at a minimum, for the following situations: Full or partial PSAP outage, E9-1-1 network failure, serving/E9-1-1 Control Office switch failures, and natural or manmade disasters which may affect any portion of the 9-1-1 network/system.

7.2 Considerations for Selecting a Backup Location

It is emphasized that the first objective of the disaster recovery plan should be to route the voice call to the PSAP that the local jurisdiction designates. ANI and ALI are desirable, but are secondary objectives. The following should be considered when deciding which PSAP to designate as the back-up PSAP in the disaster recovery plan:

- Availability of ANI and ALI
- Normal call volume at the designated PSAP; will it be able to handle the extra load?
- Direct Trunking connectivity
- Ability to dispatch the originating PSAP's emergency response units

Additional items for selecting and setting up an evacuation / backup center:

Network Element	Investigative Approach
Alternative Backup - Call forward	If the Backup site location is not manned, is there an alternative backup location where the 9-1-1 calls could be forwarded until the backup site is operational?
Backup - power	Is the backup site provisioned with backup power?
Backup - PSTN	Is the backup site capable of receiving Public Switched Telephone Network (PSTN) calls?

Network Element	Investigative Approach
Backup - responsibility	Did the 9-1-1 service provider provide written backup activation procedures to the customer?
Backup - responsibility	Does the customer/agency understand his and the 9-1-1 service provider's backup responsibility?
Backup - responsibility	Does the customer/agency agree to fulfill his backup responsibilities?
Backup - responsibility	Are the PSAP's supervisory staff and attendants aware of the agreed backup procedures?
Backup - responsibility	Are the 9-1-1 service provider "Control Center" technicians aware of the agreed backup procedures?
Backup - training	Are the PSAP's attendants trained to perform the agreed backup procedures?
Backup activation	Is there a schedule to perform live backup test?
Backup activation	When was the last backup site activation performed?
Backup activation	After the backup activation, were any recommendations or corrective requests issued? Were they dealt with diligently? If not, why?
Backup setup - validation	Is there a schedule to perform backup facility validation?
Backup site	Is there a backup site?
Backup site – cable	Is the backup site interconnected to the same cable facility as the Primary PSAP site?
Backup site – cable entrance	Is the backup site provisioned with dual cable entrance?
Backup site - data capability	Is the backup site equipped with ANI/ALI capable equipment?
Backup site - distance	If not, how far away is the Backup site from the Primary site?
Backup site - facility	Are there enough circuits/facilities to provide for backup activities?
Backup site - facility	Are there enough circuits/facilities to provide for backup activities?
Backup site - facility	Has a separate line group been provisioned/ ordered to distinguish PSAP calls from rerouted Primary PSAP calls?
Backup site – info	Is the backup site information logged and all facilities alarmed / monitored?
Backup site - location	Where is the backup site?
Backup site - location	Is the backup site in the same municipality, as the primary site?
Backup site - location	Is the backup site in the same location as the Primary PSAP site?
Backup site – staff	Is this site manned 24 hours per day / 7 days a week?
Backup site - status	Is the backup site fully operational?
Backup site - status	Is the backup site still suitable, as result of the site review exercise?
Backup site - telephone equipment	Is the backup site equipped with permanent telephone equipment?
Backup site - telephone equipment	Is the backup site provisioned with backup telephone equipment / sets?
Backup site - type	Is it an active Primary PSAP?
Backup site - type	Is it an active Secondary PSAP?
Backup site - type	Is it an alternative backup site (non-PSAP site)?

Network Element	Investigative Approach
Backup site - validation	When was the last time a backup facility administrative verification and validation performed?
Backup site - visit	Has the LEC visited the backup site location?
E9-1-1 Control Office – Serving End Office – carrier trunk group	Is the end office feeding the primary site using the same cable route for both E9-1-1 Control Office trunk groups?
E9-1-1 Control Office - Serving End Office – Primary PSAP (end to end)	Are the circuit design cards monitored after installation for highlighting diversity changes? By whom?
E9-1-1 Control Office to Backup site	Is the backup site connected to the same primary E9-1-1 Control Office as the primary site?
End office and site selection	Is the backup site connected to the same local end office, as the Primary PSAP site? *(Note: When available and feasible, separate end offices for the Primary PSAP and backup Primary PSAP sites are recommended to increase survivability.)*
Primary PSAP – cable entrance	Is the Primary PSAP site provisioned with dual cable entrances?
Primary PSAP – cable entrance	Is the Primary PSAP site access split between the two cable entrances, where applicable?
Primary PSAP – monitor	Do the primary PSAP monitoring procedures exist and are they understood?
Primary PSAP - power	Is the Primary PSAP site provisioned with backup power?
Primary PSAP – PSTN	Is the Primary PSAP capable of receiving PSTN calls?
Primary PSAP – telephone equipment	Is the Primary PSAP provisioned with backup telephone equipment/sets?
Primary PSAP Management Awareness	Does the appropriate level of PSAP management conduct periodic procedure reviews with all personnel to reinforce site evacuation and call taking procedures?
Serving End Office – Carrier Bay	Is the end office feeding the primary site using the same carrier bay for both E9-1-1 Control Office routes?
Serving End Office to Primary PSAP	Is it feasible to run cables from alternate end offices to the Primary PSAP?
Serving End Office to Primary PSAP – cable	Are there separate cable routes from the terminating end office to the Primary PSAP?

Disaster recovery plans should be jointly developed by the Emergency Service Provider (ESP) and the local Exchange Carrier (LEC) and should be thoroughly tested. Testing should be conducted at least quarterly and should be incorporated into other regularly scheduled testing. A completed copy of the plan should be distributed to all involved parties.

8 Transfer Keys

It is recommended that transfer keys be established to transfer incoming 9-1-1 calls from one PSAP to its backup, in case of an incident where the primary PSAP is not able to function. The transfer key will change the routing of all incoming 9-1-1 calls from one PSAP to another.

The transfers should be made upon:

- Circuit failure, whether mechanical (back hoe cuts cable, water gets into cables) or electrical (component failure, power is lost)
- Primary PSAP unable to function (fire, flooding, evacuation owing to tornado)

The transfer method can be either manual or automatic, or a combination.

If the transfer is done manually via a physical switch, the switch should be installed at the backup PSAP as the event that requires the transfer might prevent a person at the primary PSAP from throwing it. Additionally, it serves to ensure that the personnel at the backup PSAP are aware that the calls are being transferred. Caution for switch's special circuit design to be reviewed to prevent an accidental activation due to potential network failure condition that would result in ground or short-circuit trigger.

However it is recommended that a manual "code activated" switch be used. Here, the transfer capability is established in a switch with this capability. It is accomplished by a phone call to a specific number and a code entered to effect the transfer. The benefit is that an authorized person can do this remotely.

Automatic transfers can be set up where switch alarms will trigger the transfer. This is not recommended as it may happen without responsible parties becoming aware of the event.

In all instances, it is recommended that a highly visible sign or indicator at both the primary and backup PSAPs show the condition of the transfer switch at all times.

9 Call Set-up Time

It is recommended that emergency call set-up time not exceed the average call set-up time for any other type call made by the customers of that particular serving office.

It is also strongly recommended that in all circumstances the caller hear either audible ring tone or a recording alerting them that their call is being processed.

10 Glossary of Terms

Please see NENA Master Glossary Standard of 9-1-1 Terminology