NENA-03-501
Revised October 3, 2005

NENA

Technical Information Document on

Network Quality Assurance

NENA Technical Information Document 03-501

Prepared by:
National Emergency Number Association (NENA) Network Quality Assurance Working Group

Published by NENA
Printed in USA

One Nation 9-1-1 One Number

- 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.

NENA Standard for Enhanced 9-1-1 (E9-1-1) Default Routing Assignments and Functions

NENA Standard for E9-1-1 Default Assignment and Call Routing Functions
NENA 03-008, Version 1, January 19, 2008

Prepared by:
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Published by NENA
Printed in USA

One Nation 9-1-1 One Number

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2 Introduction

This document is a complement to NENA 03-001and 03-501 documents regarding NENA recommendations for Network Quality Assurance and as deemed applicable to other NENA standards and technical information documents addressing directly or partially the subject of default routing.

The major distinguishing feature of Enhanced 9-1-1 (E9-1-1) is the ability to selectively route a 9-1-1 call to a designated Public Safety Answering Point (PSAP) based upon the caller's location. However, there are times when, even in an Enhanced 9-1-1 network, a call cannot be routed to the designated Primary PSAP. Unique and specific terminology is used to describe each set of circumstances when such call cannot be properly routed.

This document will try to depict such circumstances and to offer potential solutions to help lessen the impact on call taking and dispatch activities. It shall address both the default assignment rationale within the databases and call routing determination in the network environment.

2.1 Call Routing Facts

9-1-1 call routing accuracy may be affected by various factors ranging from lack of up-to-date identification of the subscriber's service address/calling location; delay in service order processing; default call routing rules used to support the subscriber's NPA NXX, the serving area or the network elements; the manner in which a carrier provides local end office trunking to the designated E9-1-1 Control Office; the 9-1-1 network infrastructure or even the way a reseller offers its local service.

It must be recognized that "default call routing" by definition may result in having some emergency calls reach a PSAP not directly responsible for the subscriber's location. Local authorities, E9-1-1 System Service Providers and carriers should ensure that default call routing impacts are minimized through the appropriate association of trunk groups with defined geographic areas. Further, unless using Enhanced MF (EMF) , Signaling System 7 (SS7), Internet Protocol (IP) type trunking, all carriers must provide NPA-specific MF E9-1-1 trunk groups within those exchanges served by more than one NPA.

It must also be recognized that "default" call routing is not the same as a "misroute". Misrouted calls are generally caused by incorrect information associated with the caller due to a human or mechanical failure, whereas default routed calls are caused by a lack of selective routing information.

By following the basic provisioning specifications outlined herein, carriers and service providers should be able to provide for an efficient delivery of E9-1-1 calls to a designated authority, even