Network Reliability Council Focus Group IV

Essential Communications During Emergencies
Team Report

Findings and Recommendations
Pertaining to
Emergency Service Network Reliability

January 12, 1996

Focus Group Leader: **M. Michael Foster**
GTE Telephone Operations

Focus Group Mentor: **Arthur Prest**
Cellular Telecommunications Industry Association

Report to the Network Reliability Council
by the
Essential Communications During Emergencies Team

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1. Executive Summary

Access to essential emergency communications must continue, even in the event of a network outage. Essential communications during emergencies in this report are focused on two areas:

- 9-1-1 service that enables the public to request emergency assistance.

- Government communications that enables government officials to coordinate efforts in response to an emergency or disaster.

It is important to understand how current and future networks that rely upon new technologies, e.g., commercial mobile radio services (CMRS) or cable television, can back-up existing essential communications networks such as 9-1-1. Focus Group IV of the Network Reliability Council (NRC) was asked to focus on how effectively these new services can augment and/or replace essential emergency communications networks that may be unavailable in case of a network outage. Further, the Focus Group was asked to assess the effectiveness and implementation status of the E-9-1-1 Best Practice recommendations contained in the 1993 *Network Reliability: A Report to the Nation*.

The term “Recommendation” or “Best Practice” as used in this report is as follows:

> “Recommendations are those countermeasures (but not the only countermeasures) which go the furthest in eliminating the root cause(s) of outages. None of the recommendations are construed to be mandatory.
>
> Service providers and suppliers are strongly encouraged to study and assess the applicability of all countermeasures for implementation in their company products. It is understood that all countermeasures may not be applied universally.”

The Focus Group, for the purposes of this report, is referred to as the “Essential Communications During Emergencies (ECOMM) Team”. The ECOMM Team designed questionnaires to solicit data from a wide range of traditional and new telecommunications industry companies and the public safety sector including:

- Local Exchange Carriers (LECs).
- Public Safety Answering Points (PSAPs).
- Alternate Technology Providers (ATPs).

The data requests were analyzed and followed up with several interviews. In addition, the team analyzed performance data on 9-1-1 outages as reported to the Federal Communications Commission (FCC).

The ECOMM Team found the following:

- Generally, the LECs have implemented (at the 80 to 100 % level) the original recommended Best Practices which improve communications with the PSAPs, provide diverse routing of transport facilities, improve contingency planning, establish diverse ALI database systems, improve Network Management Center procedures, and alleviate the effects of mass stimulated calling events on 9-1-1 service.
- Of the seventy-four 9-1-1 reportable outages during the period analyzed, 53 were caused by facility outages. Of the 53 facility outages, 30 (57%) were in the PSAP network and 23 (43%) were in the LEC network. Cable cuts are the major causes of these outages.
- In the PSAP networks, only 30% of the PSAPs have a dedicated link to the media and only 22% have a dedicated link to the LEC repair center. During periods of network congestion or network outage conditions, the PSAP should have the means to communicate with the public to reduce call attempts and an available link to the appropriate LEC for assistance and response.
- While 78% of the PSAPs have established some form of alternate route capability, only 28% have automatic alternate routing. Any delay caused by lack of alternate routing could result in the loss of 9-1-1 calls.
- The cellular industry handles over 18,000 calls daily to 9-1-1. Routing and identification of wireless callers are considered significant problems for emergency service providers.
- PSAP administrators indicate that if additional funding were available to them, 54% would invest in improving display capability and 39% would invest in improving the reliability of the network or Automatic Location Identification (ALI) units.

The ECOMM Team makes the following recommendations to improve essential communications during emergencies:

- LECs should continue to implement those Best Practices identified as defensive measures for interoffice facilities to eliminate single link failure points. Configuration arrangements to be considered include:

  - Providing for facility route redundancy and diversity.
  - Arranging for inter-jurisdictional call taking and/or PSAP backup location.
  - Providing for automatic alternate facility route selection via redundant tandem switch arrangements.

- PSAPs should improve their networks to eliminate single link points between end offices and the PSAP.

- PSAPs should implement those Best Practices that will provide appropriate call routing architectures to reach the media or LEC repair forces during network congestion or failure.

- LECs and PSAPs should continually work to improve information and communications flow between themselves to avoid procedural errors due to switch, facility, and software conversions.

- PSAPs should focus on improving their network and ALI reliability when funds are available.

- CMRS and cable television operators should develop, in partnership with the PSAPs, work plans to support essential communications during emergencies.

- CMRS providers should work to implement practices and standards in support of wireless caller identification (including location) for E-9-1-1.

- The former Best Practice recommendation to avoid use of CCS networks (e.g., Signaling System 7) for emergency communications was determined to be obsolete. The CCS technology and network have matured, and are now considered safe to use for emergency communications applications.

Detailed descriptions of each of the Best Practices recommended by the ECOMM Team may be found in *Section 6* of this report.

The rapid introduction of new technology, continual organizational churn within the provider industry, and cost pressures within the PSAP community lead to the major conclusions of the ECOMM team:

- There is a critical need for the provider industry and PSAP community to work more closely together to improve communications and information flow, not only during emergencies, but also in day-to-day operations.

- Proper implementation of a number of selected Best Practices will enhance the service reliability of both the LEC and PSAP networks.

- The use of alternate technologies as backup for these networks will be beneficial to service reliability.

2. Background

The FCC referred, in Docket 91-273 Second Report and Order, several issues to the newly chartered NRC. Three were assigned to the ECOMM Team for study. Specifically, the ECOMM Team was to:

- Analyze the current effectiveness of essential communications and make improvement recommendations.
- Explore how/where alternate technologies can augment essential communications during major outages or emergencies.
- Identify methods to educate the public on when and how to contact emergency response agencies during emergency/disaster situations.

2.1 Organization of the Technical Paper

Section 1:	Executive Summary
Section 2:	Background
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Section 6:	Essential Services Best Practice Recommendations
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3. Essential Communications During Emergencies Focus Team Membership

NRC Focus Group IV- Team Leader	Company Affiliation
Mike Foster	GTE Telephone Operations

No Rest II Team Champion	
Arthur Prest	Cellular Telecommunications Industry Association (CTIA)

NRC Focus Group IV- Team Members	
Bob Azzi	Sprint
Wendell Bailey	National Cable TV Association
Duane Beck	Bellcore
Mary Boyd	Texas 9-1-1 Commission and National Association of State Nine-One-One Administrators (NASNA)
Katherine Davis	Ameritech
Ed Hall	Cellular Telecommunications Industry Association (CTIA)
Tom Hicks*	National Emergency Number Association (NENA)
Jim Lankford*	Southwestern Bell Telephone
Gwen Pirtle	Sandia National Laboratories
Gary Schallmo	GE American Communications
Silas Shannon	National Communications System (NCS)
Ed Smith	AT&T

* Subteam Leaders

Data Collector & Aggregator	
Deborah Guyton, Ph.D.	Bellcore

Consultants	
Ken Ackerman	US West
Carl Foster	Bell Atlantic
Bill Mafadini	GTE Telephone Operations
Peter Reed	Pacific Telesis

4. Data Collection and Analysis Methodology

4.1 Introduction

To profile current national network reliability and identify issues associated with essential communications during emergencies, the Essential Communications During Emergencies Focus Team (ECOMM Team) reviewed current practices as well as future plans. The following sets of data were collected and analyzed:

- 9-1-1 Outage Data: reviewed ATIS NRSC 1995 Annual Report Summary for 9-1-1.
- Best Practices Questionnaire: reviewed effectiveness and implementation of E9-1-1 Best Practices by the local exchange carriers (LECs), identified in Section F of *Network Reliability: A Report to the Nation* issued in June, 1993.
- PSAP Questionnaire: profiled communications for emergency services (e.g., 9-1-1, 7-digit emergency numbers, etc.), and 9-1-1 at Public Safety Answering Points (PSAPs), Law Enforcement, Fire, Emergency Medical Services (EMS), and other agencies taking emergency calls.
- Alternate Technology Providers Questionnaire: determined current support and future plans for essential communications by alternate technology providers including wireless, satellite, mobile satellite, cable television (CATV), and competitive access providers (CAPs).

The NRC designated Bellcore as the central point for requesting, collecting, compiling, and aggregating the data. All data were treated as proprietary information, and specific references to individual respondents were removed during the aggregation process. All information provided to Bellcore by the LECs and alternate technology providers is protected under a nondisclosure agreement. Each ECOMM Team member having access to the sample data also signed a nondisclosure agreement.

The FCC directed the NRC to obtain a view of all segments of the industry. The companies surveyed represented over 90% of the subscribers in each industry segment. Table 4-1 shows the number of companies surveyed by industry segment.

Industry Segment	No. of Companies
Local Exchange Carrier (LEC)	12
Interexchange Carrier (IC)	6
Cellular	18
Cable Television (CATV)	9
Satellite, Mobile Satellite	9
Competitive Access Provider (CAP)	1
Supplier	14
Total	**69**

Table 4-1 Number of Companies Surveyed, by Industry Segment

Exhibit E-1 lists the companies surveyed by industry segment type, and indicates which ones returned a questionnaire for use by the ECOMM Team.

The following subsections describe each set of data collected.

4.2 9-1-1 Outage Data Collection and Analysis Process

The Network Reliability Steering Committee (NRSC), under the auspices of the Alliance for Telecommunications Industry Solutions (ATIS), was formed to monitor network reliability utilizing major outage reports submitted pursuant to FCC Docket 91-273. The Data Assembly and Analysis Team, an NRSC team, has published weekly summaries of FCC-reportable outages. This has been, and continues to be, an excellent information sharing tool that carriers use to monitor problems in other networks to eliminate or minimize the duration of similar outages in their own networks. In addition, the team has issued quarterly reports that track the number and impact of outages by quarter and further break these outages down by failure category (e.g., Local Switch, Tandem Switch, Common Channel Signaling (CCS)).

In April, 1992, the FCC required service providers to begin reporting outages of 30 minutes or more that potentially affected 50,000 or more customers. Shortly thereafter, this was changed from 50,000 to 30,000 or more customers. In August, 1994, the FCC also required changes which included the additional reporting of fire-related incidents potentially affecting 1,000 or more lines and reporting of 9-1-1 special facility outages when more than 25% of the lines to any PSAP are affected (where automatic rerouting to an alternate PSAP does not exist).

Final outage reports were to include root cause analysis and how NRC Best Practices may have prevented or mitigated the effects of the outage. As a result of the ambiguity of the language contained in the August Docket, the FCC recently modified reporting rules for 9-1-1 outage reporting.

In Section 5.2, the outage results cover a 3-year window: Report Year 2 (July 1, 1994, to June 30, 1995), Report Year 1 (July 1, 1993, to June 30, 1994), and the Baseline Year (July 1, 1992, to June 30, 1993). This summary is only part of the ATIS NRSC 1995 Annual Report analysis, which uses an outage index that provides a measure of the relative importance or impact of outages on the public. In addition, the analysis provides information on outage frequency, duration, and customers affected. Section 5.2 focuses on only the special facilities analysis and 9-1-1 service outages. The reader should read the 1995 Annual Report: Best Practices Can Work, Network Reliability Steering Committee, for the complete set of results on network outages.

4.3 Best Practices Questionnaire

4.3.1 Best Practices Questionnaire Description

The ECOMM Team worked with the NRC Best Practices Team to determine the extent of implementation, cost and effectiveness of 9-1-1 Best Practices contained in *Network Reliability: A Report to the Nation*, Section F. The LECs were questioned about implementation status of the Best Practices for metropolitan and non-metropolitan areas to determine whether there were any demographic differences.

A copy of the Best Practices Questionnaire is included as Exhibit E-2.

4.3.2 Best Practices Data Collection and Analysis Process

Best Practices Questionnaires were sent to 12 LECs surveying them on the twenty-seven 9-1-1 Best Practices. All LECs responded.

4.4 PSAP Questionnaire

4.4.1 PSAP Questionnaire Description

The PSAP Questionnaire was designed to meet the following objectives:

- Profile current PSAP communications links, whether single, redundant, or diverse. These links include those from the PSAP to the Automatic Location Identification (ALI) database and, if applicable, to police, fire, emergency medical services, poison control, trauma centers, the local media, and a dedicated ring down line to the LEC to report problems in network communications during emergencies.

- Profile the PSAPs' perception concerning the reliability of those links from Very High to Very Low.
- Determine redundancy of the ALI database and, if redundant, whether geographically diverse.
- Determine whether the ALI database(s) is (are) located at the LEC or PSAP.
- Determine availability of a designated alternate PSAP and, if deployed, whether the method of rerouting to that PSAP is automatic, manual by the PSAP, or manual by the LEC.
- Assess types of outages experienced by the PSAPs in the last 12 months, whether due to the LEC network, PSAP Customer Premise Equipment (CPE), the ALI database, or other factors.
- Assess whether contingency plans have been implemented for the PSAPs or for LEC network failures.
- Obtain input on how PSAPs would spend resources to enhance their reliability.
- Obtain input on other network reliability practices that should be evaluated.
- Obtain input on special arrangements the PSAPs use today if the LEC network fails.

The PSAPs also were asked to specify whether they were in a metropolitan area or non-metropolitan area in order to evaluate whether there were demographic differences.

A copy of the PSAP questionnaire is included as Exhibit E-3.

4.4.2 PSAP Data Collection and Analysis Process

The PSAP Questionnaire content was designed by the entire ECOMM Team. The questionnaire was reviewed by representatives of the National Emergency Number Association (NENA), the National Association of State Nine-one-one Administrators (NASNA), and the Association of Public-safety Communications Officials (APCO).

Bellcore produced the final PSAP Questionnaire and processed the mailing to all of the PSAPs. A cover letter was included in the mailing explaining the purpose of the questionnaire as well as indicating that all individual responses would be kept confidential. A pre-addressed return envelope was included to increase response rate.

Bellcore responded to over 300 telephone calls to assist the PSAPs with the questionnaire. Most of the calls were from rural areas and many were from police and fire departments. The majority of the callers did not understand link diversity, indicating a need for better understanding of network architectures. The PSAPs provided many useful comments that helped with the analysis.

Bellcore contacted PSAPs that had conflicting or incomplete information to clarify responses where possible. In order to remain anonymous, some PSAPs did not provide the requested contact.

The final round of analysis included 549 questionnaires, an 11% response. For the 549 questionnaires returned, 336 were from metropolitan areas (metro) and 213 were from non-metropolitan (non-metro) areas.

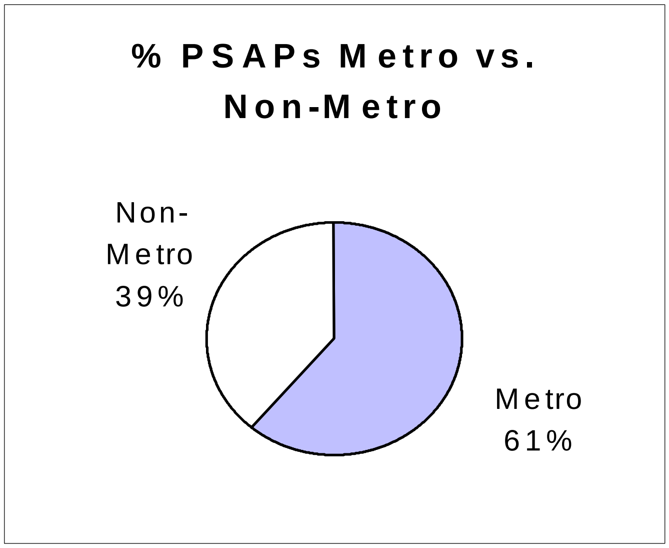


Figure 4-1 PSAP Respondent Distribution

This split was based on the Metropolitan Statistical Area (MSA) definition which includes as a metropolitan area a city with a population of at least 50,000 or an urbanized area of at least 50,000 in a county of over 100,000. All others were considered non-metro. Exhibit E-4 shows a map of the 48 States (excluding Hawaii and Alaska) that shows the MSAs as well as a dot for each PSAP in the study. The table in Exhibit E-5 provides a count of PSAPs responding by State. In general, there was good coverage across the country. Florida, New York City, and some of the western states had sparse responses.

The types of sites responding included PSAPs, communications centers for the county or state, public safety departments, police departments, fire departments, sheriff departments and others. The contacts responding to the questionnaire from these sites had a diverse set of titles and level of understanding of the network partially explaining the diversity of responses and interpretation of the questions. Some of the contact titles include PSAP or 9-1-1 Coordinators, Communications Director, Telecommunications Specialist, Public Safety Dispatcher, Chief of Police, County Sheriff, Lieutenant, Sergeant, Fire Chief, County Planner, Administrative Assistant, Training Coordinator, Jail Administrator, Telephone Switch Foreman, and LEC Contact.

The data were aggregated separately for metro and non-metro areas. In many cases, there were no significant differences in the results. In the analysis where there were no differences, the metro and non-metro area data were combined. Only when there is a significant difference will the two sets of data be presented separately in this report. For questions requiring text responses, the responses have been condensed into lists of items in the exhibits for review by the reader. For each question, a summary of conclusions will be presented with supporting data and graphics. Recommendations for significant results are provided in this report.

4.5 Alternate Technology Provider (ATP) Questionnaire

4.5.1 ATP Questionnaire Description

The ATP Questionnaire content was designed by the entire ECOMM Team. The questionnaire was reviewed by representatives of the National Emergency Number Association (NENA), the National Association of State Nine-one-one Administrators (NASNA), and the Association of Public-safety Communications Officials (APCO).

The questionnaire asked the provider to identify:

- The type of services provided (e.g., wireless, satellite, CATV, or other).
- Whether 9-1-1 or E9-1-1 service is currently provided, or whether access to these services is provided.
- What access code or codes are used when access to 9-1-1 is provided.
- Whether there is routing to an emergency service other than 9-1-1.
- Whether plans exist to provide 9-1-1 or E9-1-1 in the future or provide access in the future.
- Whether they plan to pass customer name/number/location information to the PSAP.
- Whether there are other recommendations for these services.

A copy of the questionnaire is included as Exhibit E-6.

4.5.2 ATP Data Collection and Analysis Process

The final tally of responses follows:

Industry Segment	Number of Responses Requested	Number of Responses Received
CATV network	9	0
CAP	1	1
Wireless network	18	14
Satellite, Mobile Satellite	9	8
Total	**37**	**23**

Table 4-2 ATP Survey Responses Requested and Received, by Industry Segment

An ECOMM Subteam performed a number of interviews to obtain further detail and to include companies that did not fill out the questionnaire. Conclusions and recommendations are being presented based on the compiled information from the questionnaires as well as the interviews. No contacts for the CAPs were identified; however, one company volunteered to participate and returned the questionnaire.

5. Study Analysis and Findings

5.1 Introduction

This section provides analysis and findings based on several sources, including the questionnaires discussed in Section 4 of this report, the Alliance for Telecommunications Industry Solutions (ATIS) reports, field visits and presentations by professionals from the public safety sector.

5.2 9-1-1 Service Outage Analysis and Findings

The NRSC has noted in nearly every Quarterly ATIS Report that 9-1-1 service outages are impacted most generally by a failure of the network (e.g., facility, switch) and not by direct failure of the 9-1-1 equipment. The majority of outages that affect 9-1-1 service also affect other services. In general, the failure categories of these outages have tracked with outages affecting more than 30,000 lines. Over 70% of the outages affecting less than 30,000 lines were reported due to the FCC's 9-1-1 service requirements. To ensure that other potential problems (e.g., PSAP grounding) were not overlooked, 9-1-1 service outages reported under the Special Facilities reporting requirements were also analyzed by ATIS.

Figure 5-1 shows the number of 9-1-1 service-affecting outages reported, by failure category. The category "Facility" accounts for 72% of the outages. Inadequate or no notification prior to digging was the leading cause of these type outages, followed by digging errors.

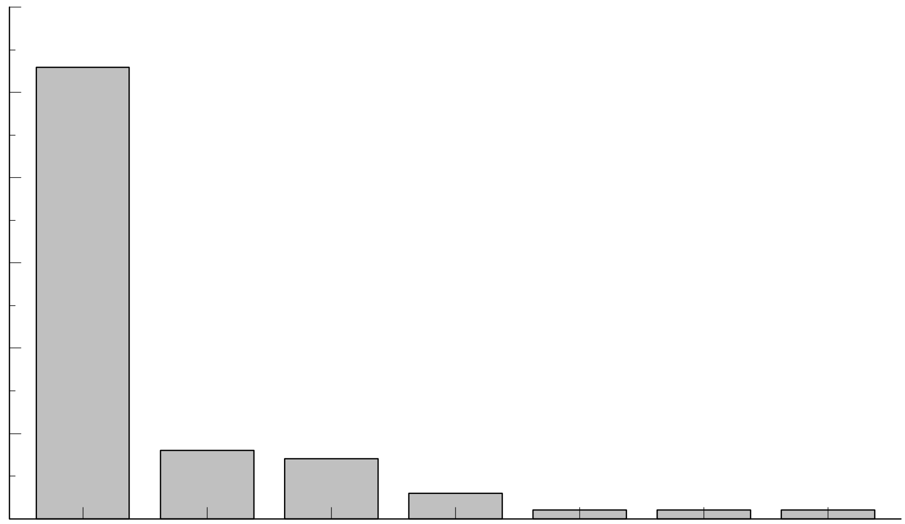


Figure 5-1 9-1-1 Special Facilities Outages, by Failure Category

In Figure 5-1, the category "Other" is made up of failures that occurred as a result of lightning striking a PSAP. In all cases, the lightning strike created a ground fault that fed back into the Tip and Ring cable, causing the Tip and Ring fuses to blow, disabling all trunks serving the PSAP. In one case, the fault also damaged two answering position displays that required replacement. Power and grounding surveys were performed and AC power feed and grounding problems were found. In most cases, the AC power and grounding layout was scheduled to be corrected, and AC surge protection and secondary Tip and Ring protection were added to the 9-1-1 equipment.

It should be noted however, that in many cases, responsibility for proper grounding rests with the PSAP operator, not the service provider. In these cases, the service provider can do little more than recommend and encourage the PSAP operator to correct the problem. In light of the number of occurrences of this problem, the NRSC suggests that service providers perform power and grounding surveys at all PSAP locations to detect and correct any power feed or grounding problems for which they are responsible and to work closely with PSAP operators to identify the steps required to correct the problems which fall under PSAP control. The ECOMM Team concurs with this NRSC suggestion.

5.3 Best Practice Implementation Analysis and Findings

All local exchange carriers (LECs) provided with a Service Provider Questionnaire returned responses to the ECOMM Team for analysis. Their responses provided information on:

- Their respective level of implementation of each Best Practice.
- Their perceived level of effectiveness of each Best Practice.

- Their categorical estimation of costs to implement each Best Practice.

The ECOMM Team reviewed each Best Practice, and found that all except one are still valid. Results of the survey are shown on pages 16 through 18.

The earlier recommendation by the NRC E9-1-1 Focus Group to avoid using the Common Channel Signaling network (CCS), commonly known as System Signaling 7, is now considered obsolete by all 12 LECs responding to the questionnaires.

Generally, 80 to 100% of the LECs have implemented those Best Practices that provided for improved communications with the PSAP administrators, diverse routing of interoffice facilities, improved contingency planning, diverse ALI database systems, improved Network Management Center procedures, and alleviation of mass stimulated calling event impacts on 9-1-1 service. As would be expected, the higher relative cost Best Practices show a lower level of implementation.

Based on questionnaire responses, no significant differences were indicated for cost and effectiveness between metro and non-metro areas. LECs and jurisdictions should review the Best Practice categories, evaluate the applicability of the recommended practice to their existing 9-1-1 network, and implement those considered most effective. Those practices considered higher in effectiveness while also lower in cost should receive priority consideration for implementation.

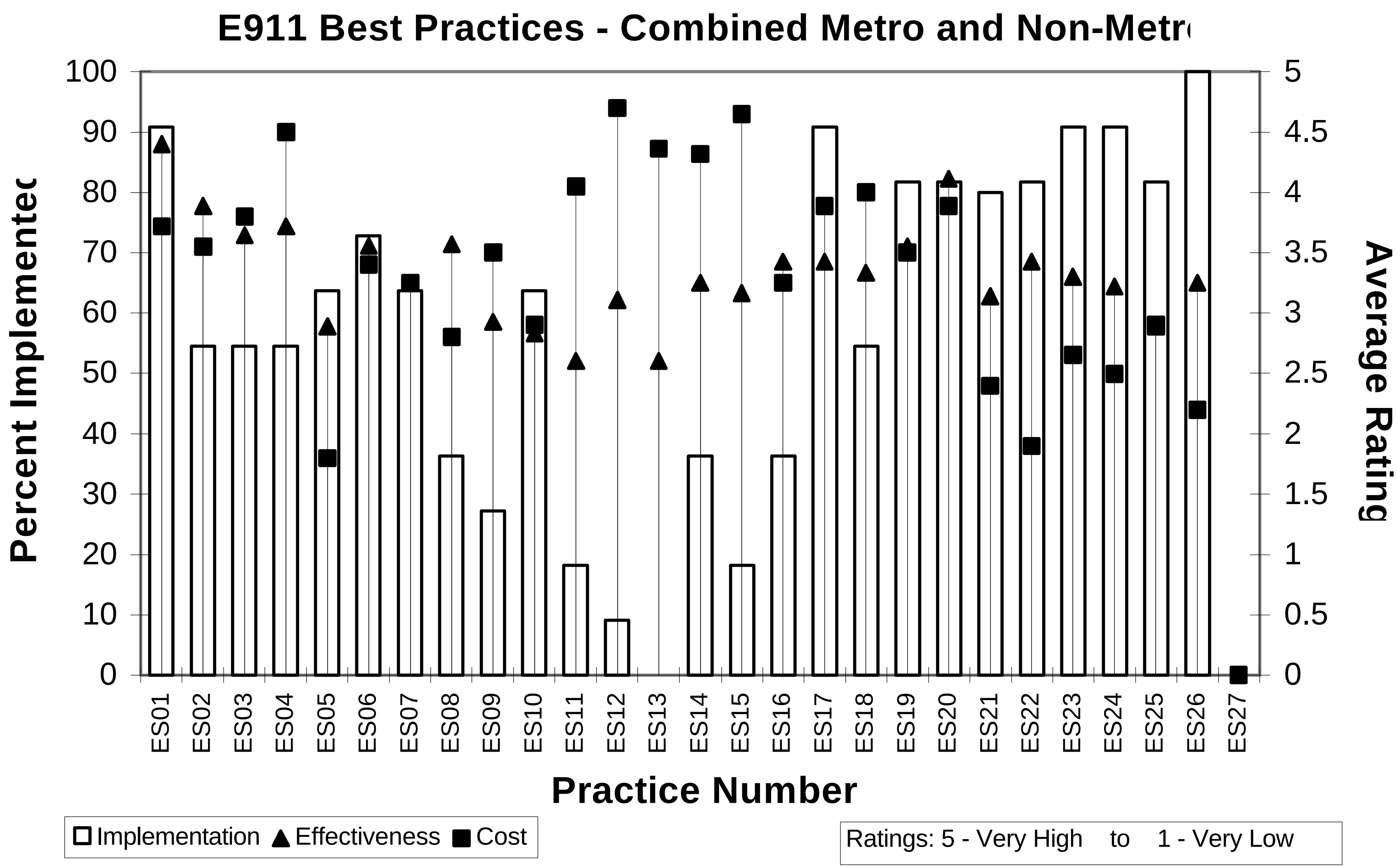
PSAP responses and outage analysis offer conflicting information when compared to some of the LEC responses which indicate high levels of implementation of selected Best Practices. For example:

- Ninety percent of the LECs claim full or partial facility diversity is implemented; however, facility failures continue to be the leading cause of FCC reportable outages. It may be that those companies indicating only partial implementation have a low level of diversity implemented (reference ES01, ES02, ES03 and ES04).

- Most LECs indicate communications with the public safety sector have improved; however, many in the public safety sector responded differently. This difference could be related to the failure to fully implement contingency planning by all parties involved (reference ES23, ES24 and ES25).

- While "Red Tagging" practices are low cost, less than 70% of the LECs have implemented such safeguards (reference ES05).

The graph on the following page shows percent implementation, level of effectiveness, and relative cost for the set of 9-1-1 Best Practices. The graph is followed by a table listing for each Best Practice the average rating for cost and effectiveness. The next table sorts these from most effective to least effective for review by the reader.



E911 Best Practices - Combined Metro and Non-Metr
Percent Implementec
Average Rating
100
90
80
70
60
50
40
30
20
10
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
ES01 ES02 ES03 ES04 ES05 ES06 ES07 ES08 ES09 ES10 ES11 ES12 ES13 ES14 ES15 ES16 ES17 ES18 ES19 ES20 ES21 ES22 ES23 ES24 ES25 ES26 ES27
Practice Number
Implementation
Effectiveness
Cost
Ratings: 5 - Very High to 1 - Very Low

ID	Recommendation	June 1993 Report* Reference	Average Rating Cost	Average Rating Effectiveness
ES01	50% of 911 Circuits Provisioned on Each of Two Diverse Interoffice Facilities	F-6.1.1, Fig. 6-2	3.39	4.40
ES02	Automatic Switching of 911 Circuits to a Diverse Standby Protection Facility	F-6.1.1	3.40	4.00
ES03	Diverse Interoffice Facilities from Customer End Office Home onto Two Diverse DCSs	F-6.1.1, Fig. 6-3	3.70	3.71
ES04	Fiber Ring Topologies for 911 Circuits	F-6.1.1.1, Fig. 6-4	4.50	3.78
ES05	Red-tagged, Diverse Equipment within a Central Office	F-6.1.4	1.80	2.89
ES06	Alternate PSAPs off the 911 Tandem Switch	F-6.1.3.1, Fig. 6-7	3.30	3.56
ES07	Alternate PSAPs off the End Office	F-6.1.3.1, Fig. 6-7	3.10	3.25
ES08	Public Switched Network as Back-up for 911 Dedicated Trunks	F-6.1.3.3, Fig. 6-9	2.80	3.57
ES09	Cellular Network as Back-up	F-6.1.3.4, Fig. 6-10	3.50	3.00
ES10	Intraoffice Call Termination to Mobile PSAP when Office is Isolated	F-6.1.3.5, Fig.6-11	3.00	2.67
ES11	Back-up PSAP Permanently Located Within the Central Office	F-6.1.3.5	4.10	2.60
ES12	Two 911 Tandems to Serve a Single Customer and the PSAP	F-6.1.2.1, 6.2.1, Fig. 6-5	4.70	3.22
ES13	Re-homing to Back-up 911 Tandem Switch	F-6.1.2.2, 6.2.2, Fig. 6-6	4.45	2.60
ES14	Diverse Paired 911 Tandem Switches	F-6.2.1	4.27	3.25
ES15	Multiple Diverse 911 Tandem Switches with Paired Diverse DCSs	F-6.2.2, Fig. 6-6	4.60	3.17
ES16	Operator Services Tandem as Backup for 911	F-6.1.3.2, Fig. 6-8	3.30	3.29
ES17	Evaluate Trend toward Increased Concentration of 911 Capabilities	F-1.3, 6.2	3.89	3.57
ES18	Local Loop Diversity for Larger PSAPs	F-6.3	4.05	3.33
ES19	911 Network Management Center & Procedures to Manage and Prioritize Repairs	F-6.4	3.50	3.60
ES20	Diverse ALI Database Systems	F-6.5, Fig. 6-14	3.89	4.11
ES21	Move Mass Calling Stimulator Away from 911 Tandem Switch	F-6.6, Fig. 6-15	2.40	3.14
ES22	Pre-planning and Cooperation to Minimize Effects of Mass Calling Events	F-6.6	1.90	3.43
ES23	Contingency Plan Development for Emergency 911 Service	F-6.7.1	2.70	3.30
ES24	Contingency Plan Training for Emergency 911 Service	F-6.7.1	2.50	3.22
ES25	Public Education on Proper Use of 911 Service	F-6.7.1	2.90	2.89
ES26	Improve Communications Among LECs, Administrators & Public Safety Agencies	F-1.3	2.20	3.25
ES27	Defer Use of CCS Network Until Protocol Issues Addressed by Standards Bodies	F-1.3, 6.7	-	-

* *Network Reliability: A Report to the Nation*, Federal Communications Commission's Network Reliability Council, June 1993.

ID	Recommendation	June 1993 Report Reference	Average Rating	
			Cost	Effectiveness
ES01	50% of 911 Circuits Provisioned on Each of Two Diverse Interoffice Facilities	F-6.1.1, Fig. 6-2	3.39	4.40
ES20	Diverse ALI Database Systems	F-6.5, Fig. 6-14	3.89	4.11
ES02	Automatic Switching of 911 Circuits to a Diverse Standby Protection Facility	F-6.1.1	3.40	4.00
ES04	Fiber Ring Topologies for 911 Circuits	F-6.1.1.1, Fig. 6-4	4.50	3.78
ES03	Diverse Interoffice Facilities from Customer End Office Home onto Two Diverse DCSs	F-6.1.1, Fig. 6-3	3.70	3.71
ES19	911 Network Management Center & Procedures to Manage and Prioritize Repairs	F-6.4	3.50	3.60
ES08	Public Switched Network as Back-up for 911 Dedicated Trunks	F-6.1.3.3, Fig. 6-9	2.80	3.57
ES17	Evaluate Trend toward Increased Concentration of 911 Capabilities	F-1.3, 6.2	3.89	3.57
ES06	Alternate PSAPs off the 911 Tandem Switch	F-6.1.3.1, Fig. 6-7	3.30	3.56
ES22	Pre-planning and Cooperation to Minimize Effects of Mass Calling Events	F-6.6	1.90	3.43
ES18	Local Loop Diversity for Larger PSAPs	F-6.3	4.05	3.33
ES23	Contingency Plan Development for Emergency 911 Service	F-6.7.1	2.70	3.30
ES16	Operator Services Tandem as Backup for 911	F-6.1.3.2, Fig. 6-8	3.30	3.29
ES07	Alternate PSAPs off the End Office	F-6.1.3.1, Fig. 6-7	3.10	3.25
ES14	Diverse Paired 911 Tandem Switches	F-6.2.1	4.27	3.25
ES26	Improve Communications Among LECs, Administrators & Public Safety Agencies	F-1.3	2.20	3.25
ES12	Two 911 Tandems to Serve a Single Customer and the PSAP	F-6.1.2.1, 6.2.1, Fig. 6-5	4.70	3.22
ES24	Contingency Plan Training for Emergency 911 Service	F-6.7.1	2.50	3.22
ES15	Multiple Diverse 911 Tandem Switches with Paired Diverse DCSs	F-6.2.2, Fig. 6-6	4.60	3.17
ES21	Move Mass Calling Stimulator Away from 911 Tandem Switch	F-6.6, Fig. 6-15	2.40	3.14
ES09	Cellular Network as Back-up	F-6.1.3.4, Fig. 6-10	3.50	3.00
ES05	Red-tagged, Diverse Equipment within a Central Office	F-6.1.4	1.80	2.89
ES25	Public Education on Proper Use of 911 Service	F-6.7.1	2.90	2.89
ES10	Intraoffice Call Termination to Mobile PSAP when Office is Isolated	F-6.1.3.5, Fig.6-11	3.00	2.67
ES11	Back-up PSAP Permanently Located Within the Central Office	F-6.1.3.5	4.10	2.60
ES13	Re-homing to Back-up 911 Tandem Switch	F-6.1.2.2, 6.2.2, Fig. 6-6	4.45	2.60
ES27	Defer Use of CCS Network Until Protocol Issues Addressed by Standards Bodies	F-1.3, 6.7	-	-

* *Network Reliability: A Report to the Nation*, Federal Communications Commission's Network Reliability Council, June 1993.

5.4 PSAP Analysis and Findings

The previous NRC study focused on 9-1-1 voice and ALI links, as well as ALI system reliability issues. However, there are other critical emergency communication links that are also vital to the delivery of emergency aid during disasters, as well as routine emergency assistance. Therefore, these must also be considered.

Included in the ECOMM Team analysis were PSAP questions regarding network links to the following locations: ALI systems, law enforcement agencies, emergency medical service (EMS) response units, fire departments, poison control centers, trauma centers, media organizations, and LEC repair centers.

5.4.1 PSAP Perceived Network Link Reliability

Based upon responses received from those public safety community respondents having redundant links for these applications, the perceived facility diversity applied is shown in Figure 5-2.

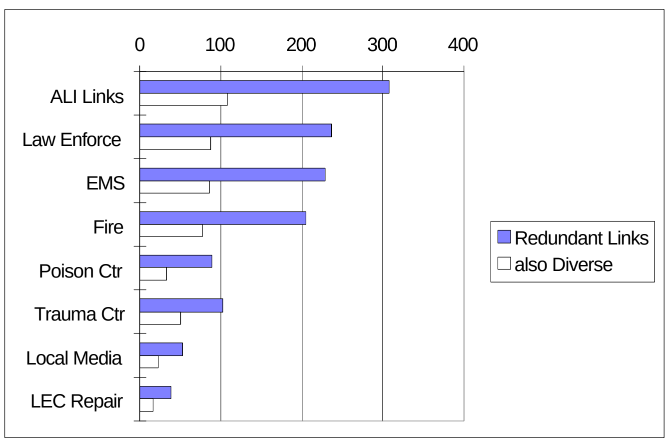


Figure 5-2 PSAP Perceived Number of Redundant and Diverse Links

Only 163 of 549 respondents have a dedicated link to the media. It is imperative during 9-1-1 impairments and/or overload conditions to inform the public to call 9-1-1 for emergencies only, and to call a backup telephone number for non-emergency purposes. Media organizations play a vital role in educating the public on the proper use of the public safety networks.

Equally important is a PSAP's ability to reach LEC repair organizations during times of service interruption or degradation. These links are vital to a jurisdiction's ability to respond to emergency situations and service interruptions. Analysis revealed that only 119 of 549 respondents have a dedicated link to the LEC. Although most LECs pro-actively detect failures in the 9-1-1 network, the degree of detection may be limited by the technology deployed for public safety networks. LECs play a major role in service restoration during such events.

Both media links and dedicated links to the LEC are highly important during times of natural disasters or other events that may create congestion in the public safety network.

Figures 5-3 and 5-4 show the percent of PSAPs perceiving link reliability as "high or very high" when critical links are deployed in a single, redundant, or diverse manner.

The data also shows a perceived trend in improvement in reliability if network links are provisioned over redundant and/or diverse facility routes. Further, it is likely that improvements are more significant in non-metro areas because of the longer facility lengths that are generally present in remote applications.

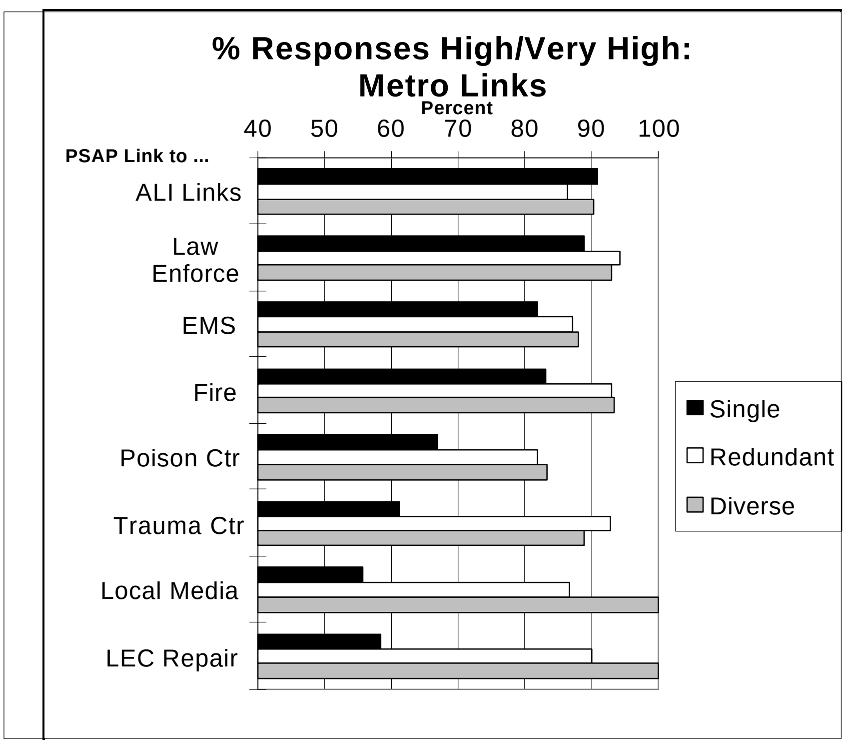


Figure 5-3 Metro Users - PSAP Perceived Link Reliability

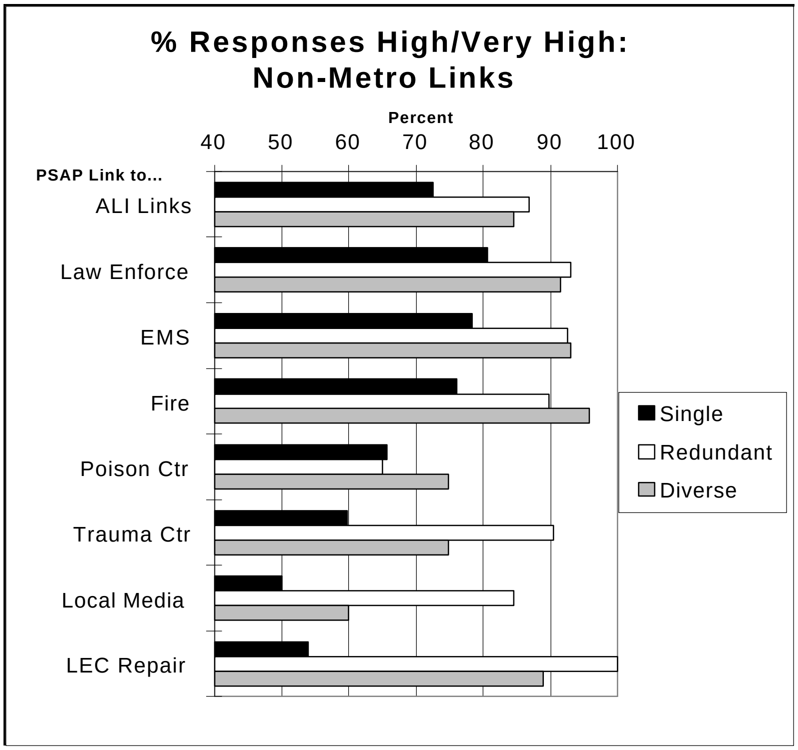


Figure 5-4 Non-Metro Users - PSAP Perceived Link Reliability

In summary, the analysis of the PSAP responses indicate that a jurisdiction's ability to respond to emergency situations is improved if redundancy *and* diversity are considered for network connections to locations housing response and/or dispatch personnel.

5.4.2 PSAP Automatic Location Identification (ALI) System Reliability

Automatic Location Identification (ALI) distinguishes Enhanced 9-1-1 (E9-1-1) services from basic 9-1-1. With ALI, a caller's location and other information are provided to the 9-1-1 call taker to aid in determining how to respond to the request for emergency assistance. Many PSAPs have become heavily reliant on ALI to guide them in decisions concerning which personnel to send and the level of assistance required. Reliable delivery of ALI data is also considered vital to a PSAP's ability to respond to 9-1-1 callers that cannot speak or do not know where they are.

Since interruption of the ALI system can significantly impede a jurisdiction's ability to deliver an appropriate level of response, many LECs provide ALI systems that are redundant (i.e., having two mirrored-image data bases). This arrangement provides for uninterrupted ALI delivery if one data base fails.

For the PSAPs having redundant ALI systems, 86% perceive the reliability as high or very high, while only 79% of those without ALI system redundancy feel the same way. Of those having redundant ALI systems, 66% have deployed the backup system in a separate geographic location, which further minimizes the potential impact of natural disasters.

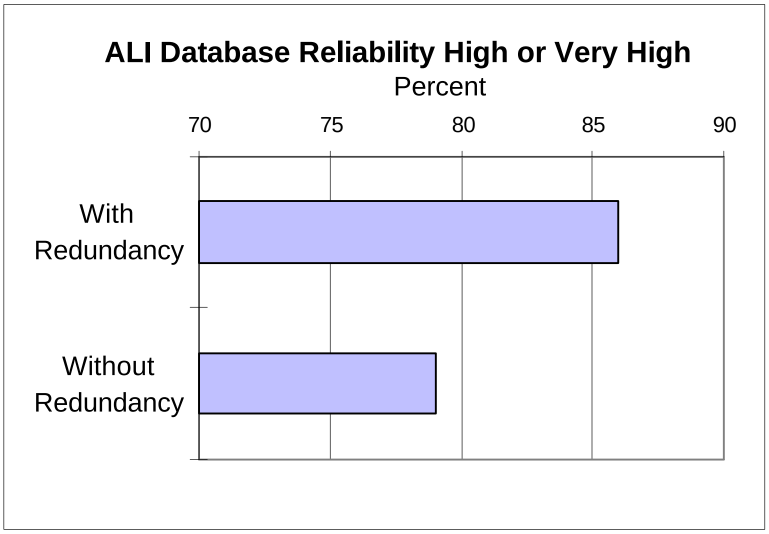


Figure 5-5 PSAP Perceived Database System Reliability

5.4.3 PSAP Alternate Route/Location for Outage or All Trunk Busy Conditions

In the previous NRC study, best practice recommendations urged the establishment of alternate route selection when the primary 9-1-1 call center was all-paths-busy or when the primary route failed. It also suggested that PSAPs establish backup arrangements with other jurisdictions or initiate automatic alternate routing of 9-1-1 calls to an internal emergency response unit.

Of the PSAPs responding to the questionnaire, over 78% have established alternate route capability. As shown in Figure 5-6, only 28% of those respondents with alternate routing capability have automated activation arrangements. Figure 5-6 also shows how alternate routing is being handled by the respondents.

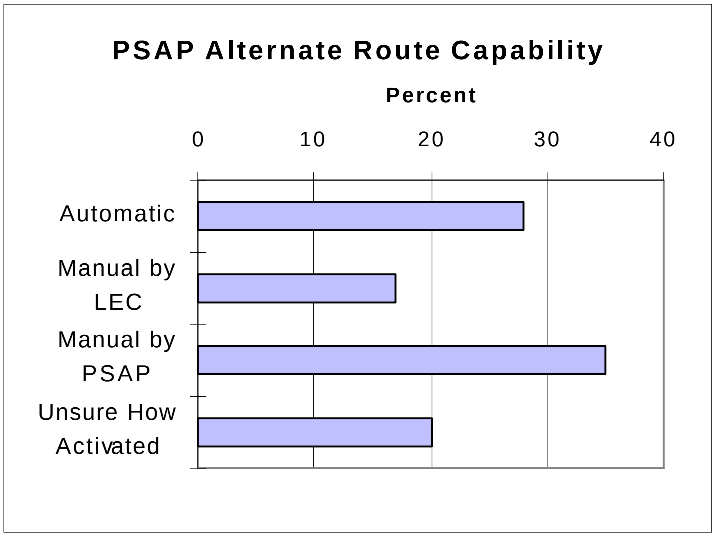


Figure 5-6 Percent Alternate Routing, by Type

The ECOMM Team agrees with the NRC E9-1-1 Best Practices (ES06 through ES11) of establishing alternate routing to 9-1-1 callers whenever the primary path is busy or interrupted. The ECOMM Team further endorses automatic rerouting capabilities so that no calls are lost as a result of such call events.

While better than no alternate routing, manually activated rerouting does not accommodate periodic overflow or momentary failure conditions. Manually activated alternate routing reduces call completion reliability, and is considered a reactive rather than a proactive network safeguard.

5.4.4 PSAP Comments Related to Private Switch ALI (PSALI) Arrangements

Many of the PSAP respondents indicated a concern for providing the same level of E9-1-1 service reliability for community members served by privately owned telephone switches (e.g., private branch exchanges [PBXs], alternative LECs [ALECs], and competitive LECs [CLECs]). In most of these applications, the PSAP does not have access to location identification for these end users.

Most LECs have recently introduced tariffs and service offerings to include ALI for these applications, but few of these alternative providers have chosen to participate or have yet to deploy the technology that will support ANI/ALI operation. The ECOMM Team believes that alternative providers should make every effort to enable PSAP access to location identification for their end users.

5.4.5 Other PSAP Special Arrangements

While the majority of the respondents identified traditional backup arrangements, such as alternate wireline routes, radio, generators, or call boxes, 24.4% of PSAP respondents use some form of alternate technology to back-up the LEC wireline network. Figure 5-7 identifies which alternate technologies are being used.

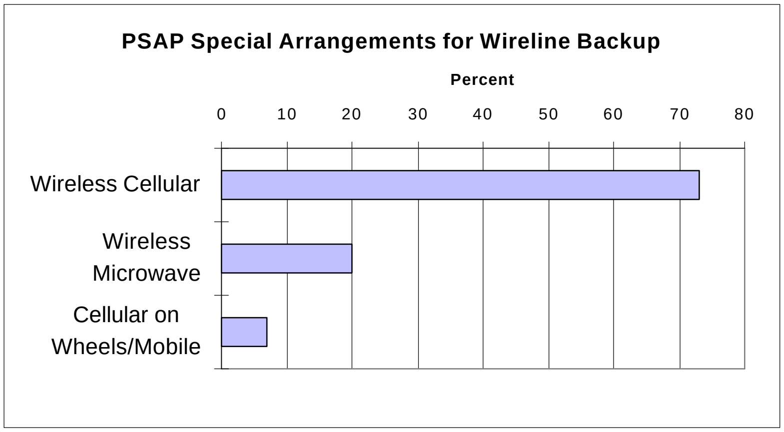


Figure 5-7 PSAP Special Arrangements for Wireline Backup

Cost recovery for enhanced services for alternate technologies can be obtained through existing funding mechanisms. This is frequently accomplished through a dedicated fee assessment on each local access to intrastate toll, and should also be applicable to wireless and CATV services.

5.4.6 PSAP Spending Priority

When asked which enhancements would most benefit PSAP reliability, the responses were divided as follows:

- Fifty-four per cent indicated a desire to establish and/or improve the quality of information displayed at the PSAP during a 9-1-1 call. This includes enhanced displays using Geographic Information Systems (GIS) and Computer Aided Dispatch (CAD) systems, as well as location identification of wireless and PBX users.

- Twenty-eight per cent indicated they would invest in some form of redundancy in their networks, PSAPs, and/or ALI data base systems.

- Eleven per cent expressed a willingness to invest in new features that would improve network quality (e.g., circuit monitoring, automatic trunk testing, improved tracing) or improve ALI data quality or the data delivery cycle.

- The remaining 7% indicated they would invest in other PSAP administrative needs (i.e., training, public awareness).

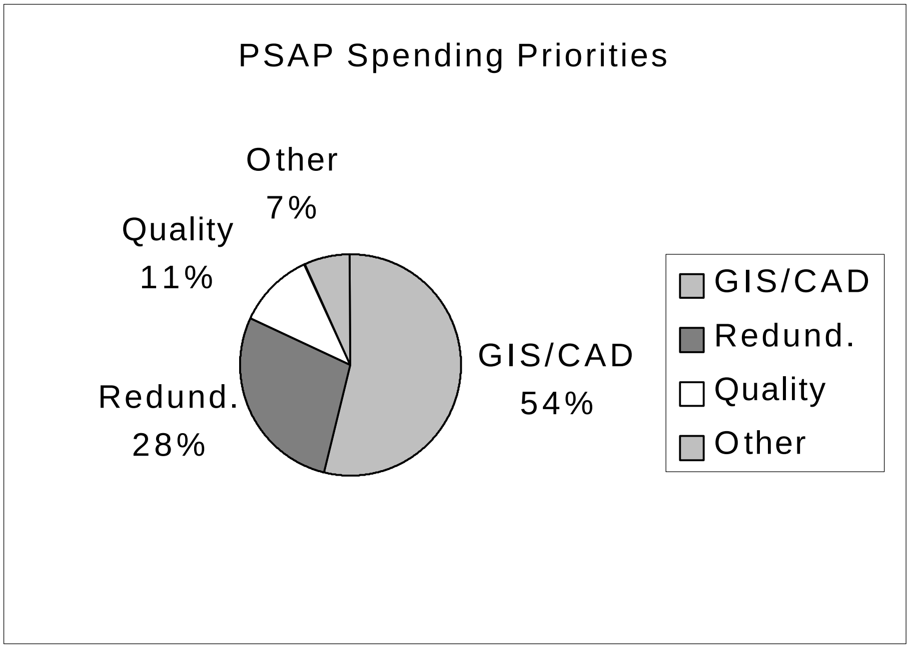


Figure 5-8 PSAP Spending Priorities

Many responses were received that were beyond the scope of this study effort. However, because of the value of these responses to others in the public safety community, they have been summarized in Exhibit E-7.

It is important to note that 9-1-1 funding legislation currently exists in 49 States. Of these, 28 States have committed to a dedicated statewide program with goals for statewide implementation of 9-1-1. Such provisions include covering both recurring and non-recurring costs for network and customer premises equipment, and given the availability of funds could provide for network reliability improvements. Currently 18 of the 28 States have invested over $1.6 billion in 9-1-1 equipment and services.

5.5 Alternative Technology Provider Analysis and Findings

5.5.1 Commercial Mobile Radio Services (CMRS)

CMRS, as used in this document, includes 800 megahertz (MHz) cellular, 1800 MHz personal communications service (PCS), mobile satellite services (MSS) and enhanced specialized mobile radio (ESMR).

The cellular industry handles approximately 18,000 9-1-1 calls per day nationwide. The majority of these calls are routed through wireline providers to the appropriate PSAP. However, the current Basic 9-1-1 and Enhanced 9-1-1 systems do not address unique characteristics of wireless communications systems.

In the current environment:

- 9-1-1 routing systems can route wireless calls to an incorrect PSAP.

- Wireless service areas do not necessarily correspond to the serving areas of the emergency service providers.

- Wireless systems do not provide a call-back number for the wireless caller nor can it provide position location information at the resolution level desired by the emergency services community.

- There are no mandatory emergency services (9-1-1) national standards for interconnecting wireless 9-1-1 calls into the wireline 9-1-1 system.

- There are a number of new industry practices and recommendations employed by wireless carriers. These practices and recommendations have been documented in the Telecommunications Industry Association's (TIA) IS-93 and Bellcore's TR-NPL-000145, Issue 2.

  The wireless industry sponsored 2 Joint Experts Meetings during 1994 and developed a list of 19 “9-1-1 Call-Taker Features”. This list has been actively pursued by various wireless industry bodies and is currently being developed into standards requirements by TIA.

- There are no mandatory emergency services (9-1-1) standards that address PSAP console issues.

Automatic Number Identification (ANI), used for caller identification and call-back in most wireless systems, is not passed to the PSAP due to technical limitations of the interconnect between the wireless service provider (WSP) and the PSAP (via CAMA trunk). This connection (CAMA) transfers only the last seven digits of a caller’s telephone number.

In a mobile environment, the true identity of the three-digit area code (NPA) is essential for proper caller identification.

In a wireline environment, the same is true; however, a three-digit area code is arbitrarily assigned to the incoming seven-digit telephone number depending on the central office (CO) code and/or the trunk line on which the 9-1-1 call is being received. This procedure, although functional in a wireline environment, is not feasible in a wireless system due to the various three- digit area codes active in a wireless system (e.g., multiple areas codes and roaming mobile units).

WSPs have limited ability to provide ALI at the resolution required by PSAP operators. PSAP providers desire exact location information in order to alert the proper emergency response teams. In a wireline environment, the street address of the caller is obtained based on the ANI provided. In a wireless system, because an ANI is not provided, there is no simple means to determine the location of the caller. Various technologies being developed appear hopeful, but the cost of the development and implementation into a wireless system is a notable factor. WSPs are providing PSAP operators with what is referred to as a "Pseudo ANI". Using this technology, a WSP sends the location of the cell site handling the call to the PSAP for selective routing. This procedure has proven quite successful in some areas. The major weakness with this technique is that the cell site handling the mobile call may not be the cell site closest to the caller (e.g., propagation, traffic management).

There is no industry set of standards for relaying ALI information to a PSAP, however, the Cellular Telecommunications Industry Association (CTIA) in conjunction with TIA and APCO Project 31 (APCO/NENA/NASNA) is addressing 9-1-1 standards for interconnecting wireless 9-1-1 calls into the wireline 9-1-1 networks.

Due to the type of customer premises equipment (CPE) being used by some PSAPs to handle wireless originated calls, most are unable to process interLATA calls effectively. In one case, all calls are answered at a central point for a large area of responsibility, e.g., State. If someone originates a call outside the PSAP's area of responsibility, the call is either terminated to an announcement or the operator, or is call forwarded to another jurisdiction.

During times of emergencies/disasters the wireless industry has the ability to increase capacity (by adding cell sites) on their networks within a short response time. Wireless systems are commonly used to augment the existing wireline networks in providing essential communications, as evidenced by the recent Oklahoma City Federal Building bombing incident.

The ECOMM Team was unable to identify any cellular service providers that have any formal "Mutual Aid" agreements and/or formal "Disaster Recovery" plans in place. Most agreements and plans are generic in nature and few address National Security Emergency Preparedness (NSEP) issues, such as priority service during emergencies/disasters for Federal relief and law enforcement agencies.

The cellular industry has developed a service called Priority Access Channel Assignment (PACA) featuring priority cellular service (without preemption), but the service will not be universally available for several years. This issue is being addressed at the national level by the National Security Telecommunications Advisory Committee (NSTAC).

5.5.1.1 CMRS - Facility Diversity

Facility diversity between cell sites and to CMRS Mobile Switching Offices (MSOs) exists to some degree in metropolitan environments. CMRS providers use both wireline and private/leased microwave systems to achieve facility diversity.

CMRS providers have installed duplicate transceivers for frequency reuse in metropolitan areas. Antennas are placed on the cell site tower to cover a specific sector, e.g., direction.

The use of fiber cables varies among CMRS providers. Some purchase capacity from wireline providers and others have built their own fiber networks.

Refer to Section 6.1 of this document for information on installation of redundant and diverse facilities to insure network reliability.

5.5.1.2 CMRS - Cell Site Power

Battery backup power plants are the primary sources of power during an outage. Most battery plants are engineered to provide backup power for up to 8 hours. Bigger cell sites (metropolitan areas) have larger backup systems and in some cases, backup generators.

There are cases where the cell site may have a quick connect adapter for power mounted on the outside of the building. This arrangement can be found in rural areas where portable generators are the primary source of backup power during long outages.

Alternative technology providers should refer to Section E of *Network Reliability: A Report to the Nation* for recommended best practices.

5.5.1.3 CMRS - Switching Equipment

Most switches utilized to process wireless calls have redundant switch processors. If the primary processor fails for any reason, the standby processor will immediately come on-line and begin handling calls. Any call that was in progress when the primary processor failed should retain connectivity.

In cases where off-site redundant backup switches are utilized and there is a primary switch failure, any call that was established on the primary switch will be terminated. The caller will have to reestablish their call on the backup switch in order to continue communications.

Facility diversity between the primary switch and the backup switch can be achieved by leasing capacity on wireline facilities, such as fiber backbones, when they are available.

Alternate technology providers should refer to Section A of *Network Reliability: A Report to the Nation* for recommended best practices.

5.5.1.4 CMRS - People Plan

Some CMRS providers have supplied their critical employees with portable computers, equipped with high speed modems, in order to access remote switches. Critical employees are expected to work from a location that allows them access to the switches during times of emergencies/disasters.

Most CMRS providers do not have a formal contingency plan that defines where employees are to report for work if their primary work place is inaccessible, for whatever reason. Some CMRS providers have indicated they are investigating this issue and that they intend to develop plans in the future.

Alternate technology providers should consider people placement plans when performing contingency planning as discussed in Section 6.9.

5.5.1.5 CMRS - Emergency Calling

There was no consistent information derived from the questionnaires (Exhibit E-5) on which to base a view of how an alternate technology provider would provide essential communications during an emergency/disaster. Customers who use cellular phones to make 9-1-1 calls can dial 9-1-1 to get to emergency services. However, other access codes being used across the nation include *9-1-1, *HP (Highway Patrol), *DUI (Driving Under the Influence), *999, *77, *19-1-1, *COP, *HELP, *55, and/or *CG (Coast Guard).

5.5.2 Cable Television Services

There are approximately 11,600 cable television operators in the United States. The top 15 cable providers own more than one franchised system and their subscriber base accounts for 70% of all cable customers. Only 53% of cable operators have a subscriber base of 30,000 or more customers. While 70% percent of cable television is provided over aerial facilities, only 30% is underground.

Cable providers have no method of providing ANI/ALI information to PSAPs using existing embedded equipment. Cable providers will use the public switched network to provide universal service, if and when they begin providing telephone-type services. ANI/ALI issues will be addressed by technical personnel across the country prior to cable operators providing essential communication services.

One of the key issues that concerns the cable industry is number portability, e.g., a person is assigned one number for life. A special caucus of all parties concerned will be required to address technical issues on this matter.

The cable industry can provide bandwidth upon demand for a specific location during emergencies/disasters. Any additional equipment and resources would have to be acquired, shipped, and installed to meet communications demands.

On the average, it was indicated that the cable industry could respond within 4 hours to a request for essential communications. The issue of interconnectivity with wireless or wireline providers would have to be addressed. In today's telecommunications environment, cable providers see themselves as the carrier of "last resort" in the event of an emergency or disaster.

The cable industry is not prepared to provide immediate response to meet large-scale relief demands. The industry does not have formal "Mutual Aid" agreements or specific "Disaster Plans" in place. In addition, the cable industry has not addressed NSEP issues.

Cable providers depend upon support from vendors to provide equipment to meet local emergency demands; however, there are no formal "Mutual Aid" agreements among cable providers to assist each other during times of widespread emergencies/disasters. In the past, when a disaster has occurred, other cable companies have participated in restoration activities based on informal assistance programs.

Any "Disaster Plans" that the cable providers have are basic in nature and provide only generic information for that provider. However, some cable providers are beginning to address "Disaster Plan" issues as a result of questionnaires they received from the ECOMM Team.

The cable industry does not have a uniform method of tracking outages. One cable provider considers two channels to any customer to be a significant outage, while other providers consider a total loss of all channels to all customers to be significant. Some cable providers do outage analysis; however, this is the exception, not the rule. The cable industry does have Cable Labs, which is an ongoing team of experts that review outages. These experts attempt to determine the causes of the outages and then publish the results of their investigations.

The cable industry does provide Public Education and Government Channels (PEGS) for government use. However, Cable operators only provide entertainment and information, not content, for education channels. Content on the channels is controlled by local governments. Therefore, any education on essential communications would fall under the local government's jurisdiction and not the cable provider's.

Implementation of the Emergency Alerting System (EAS), per Federal law, will begin in 1996. Cable providers will have equipment in place that will allow local, regional, State, or Federal government bodies the capability to flash and make an announcement directing subscribers to tune to a specific channel for emergency/disaster information. Subscribers will be required to obtain a digital receiver in order to receive the flash and announcement.

The Cable Television industry has published a document titled *NCTA Recommended Practices for Measurement on Cable Television systems*. This document is available from NCTA. The document is technically oriented for systems engineers.

5.5.3 Two-way Radio Networks

Respondents to the ECOMM Team PSAP questionnaire indicate that they use two-way radios during wireline outages 14% of the time. Two-way radios are used extensively in rural areas. If additional funds were available, some PSAPs would install, improve, or upgrade their two-way radio system(s) to meet their need to serve the community.

A few respondents have used internal/external Amateur Radio networks during emergencies/disasters. This network is designed for general public use.

5.5.4 Microwave Systems

A few respondents to the ECOMM Team PSAP questionnaire utilize private microwave systems for communications between dispatch response personnel, e.g., PSAPs, law enforcement departments/stations, fire departments/stations. There was no indication that private microwave systems are being used for communications between LECs and PSAPs; however, there is the possibility this situation exists in rural areas.

5.6 Disaster/Contingency Planning Analysis and Findings

Essential communications includes both 9-1-1 emergency calling to a Public Safety Answering Point (PSAP) and communications during emergencies/disasters for relief agencies and law enforcement.

Figure 5-9 graphs responses received from PSAPs regarding whether they currently have disaster/contingency plans in the event of LEC network failure. Surprisingly, fewer than 50% have current plans for what they would do during a LEC network failure.

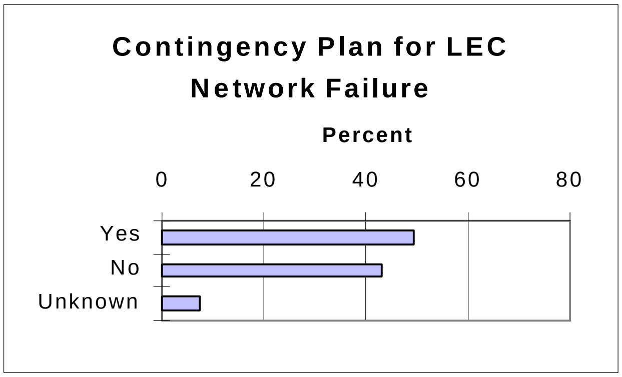


Figure 5-9 Contingency Plan for LEC Network Failure

However, it does appear that most PSAPs have performed contingency planning for what they would do, should they need to evacuate a PSAP or should the PSAP become disabled during a disaster. Figure 5-10 illustrates what percent of PSAP respondents have established a contingency plan for PSAP evacuation.

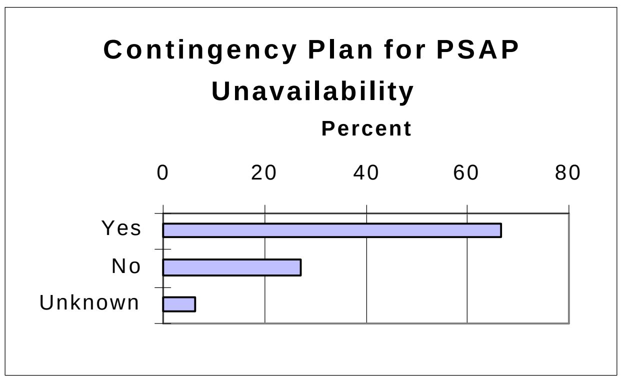


Figure 5-10 Contingency Plan for PSAP Unavailability

Responses to questionnaires were analyzed in an attempt to identify the ability to use alternative technology networks to support essential services during outages/emergencies, for current and future availability. The data provided an insight as to how wireless, cable, and satellite services are addressing essential communications today and their perception as to how they will interface in the future. Basically, the responses indicate that alternate technology networks are just beginning to address the needs of essential communications.

To validate some of the data, telephone and face-to-face interviews were conducted with representatives from the wireless and cable industries. The interviews yielded information on what these industries are doing and what they envision their role will be in providing essential communications in the future. Results of those interviews provided a better understanding of how each technology is addressing the issues associated with providing essential communications on a day-to-day basis and during emergencies.

In addition, an Emergency Planner from Southwestern Bell Telephone briefed the ECOMM Team on the Oklahoma City, Oklahoma, bombing. The bomb destroyed the Arthur P. Murrah Federal Building in downtown Oklahoma City on April 19, 1995. This resulted in heavy call volume on the wireline and wireless networks. Network management controls were remotely initiated to allow calls to originate from the affected area. Due to the bombing, Southwestern Bell local networks experienced over 12 million calls that day (normal volume is 4 million calls per day). Access to telecommunications buildings/facilities within the crime scene was restricted to authorized personnel only. Disaster recovery plans should address worst-case-scenario situations. There was no impact to the 9-1-1 services network; however, call processing was slower due to heavy call volume.

5.7 GETS (Government Emergency Telecommunications Service) Analysis and Findings

GETS is a service offered by the Office of the Manager, National Communications System (OMNCS), to meet NSEP requirements for use of public, defense, or Federal telephone networks by government departments, agencies, and other authorized users. Developed in response to White House tasking, GETS provides emergency access and specialized processing in local and long-distance telephone networks. GETS access is through a simple dialing plan and personal identification number (PIN). GETS is exempt from network management controls. Future developments will provide enhancements to this service.

5.8 Telecommunications Service Priority (TSP) System Analysis and Findings

The U.S. Government has another program called the Telecommunications Service Priority (TSP) System for NSEP to ensure priority treatment to our nation's most important telecommunication services. Under the rules of the TSP System, telecommunication service vendors are both authorized and required to provision and restore those telecommunication services with TSP assignments before services without such assignments.

Only services that qualify as NSEP are eligible for TSP assignments. The Federal Communications Commission (FCC) defines NSEP services as those "telecommunication services which are used to maintain a state of readiness or to respond to and manage any event or crisis (local, national, or international), which causes or could cause injury or harm to the population, damage to or loss of property, or degrades or threatens the NSEP posture of the United States."

Eligibility for a TSP assignment is not limited to Federal government services. State, local, and foreign governments may have telecommunication services that qualify as NSEP (e.g., 9-1-1), and certain private industry telecommunication services satisfy the NSEP definition and also meet TSP System criteria.

The TSP System establishes priority levels for both provisioning and restoration of NSEP telecommunication services. These priority levels are the basis for TSP assignments that are provided to telecommunication service vendors. The service vendors then use the TSP assignments to guide them on the sequence in which they are to respond to provisioning and restoration requirements: as a general rule, services with TSP assignments must, when necessary, be worked before other services, and TSP services should be worked in the order of their priority level assignments.

Examples of where TSP is appropriate for essential communications are as follows:

- TSP can be applied to the PSAP's dedicated access lines and dedicated interLATA lines.
- TSP can be applied to critical user communication lines if they meet NSEP qualifications, e.g., police, fire department, banks, hospitals.
- TSP should be used on dedicated circuits that are critical for communications.
- TSP applies to telecommunication facilities only (Demarcation Point).
- TSP does not apply to customer premises equipment (CPE).

5.9 Cellular Priority Access Service (CPAS) Analysis and Findings

In partnership with the National Security Telecommunications Advisory Committee (NSTAC), the Office of the Manager, National Communications Commissions System, is seeking the Federal Communications Commission's approval to establish Cellular Priority Access Service (CPAS).

CPAS will offer non-preemptive, priority queuing cellular service to the Nation's emergency responders who have national security or emergency preparedness functions.

National, State, and local governments are working with the cellular industry to provide priority access to radio channels to receive service for critical users. The administrative rules for operation of CPAS will be similar to those applicable to the TSP System, e.g., five levels of priority.

6. Essential Services Best Practice Recommendations

Best Practices are those countermeasures (but not the only countermeasures) that go furthest in eliminating the root causes of outages. *Network Reliability: A Report to the Nation* contained a total of 27 Best Practices pertaining to 9-1-1. All 27 original Best Practices have been rewritten and expanded to include alternate technologies where appropriate. These 27, and new best practices ES28 through ES33, being introduced by the ECOMM Team are categorized as follows. The ECOMM Team believes implementation of these practices will improve the reliability of the Public Switched Telephone Network (PSTN) and minimize the potential for interruption to vital emergency communications.

Category	New Best Practice No.	Former Best Practice No.
6.1 Defensive Measures for Interoffice Facilities...		
6.1.1 Diverse Interoffice Transport Facilities	ES01	112
6.1.2 Diverse Interoffice Transport Facilities with Standby Protection	ES02	113
6.1.3 Diverse Interoffice Transport Facilities Using DCS	ES03	114
6.1.4 Fiber Ring Topologies for 9-1-1 Circuits	ES04	115
6.1.5 Red-Tagged Diverse Equipment	ES05	125
6.2 Alternate Path when the Primary 9-1-1 Interoffice Facility Fails...		
6.2.1 Alternate PSAPs from the 9-1-1 Tandem Switch	ES06	118
6.2.2 Alternate PSAPs from the Serving End Office	ES07	119
6.2.3 PSTN as a Backup for 9-1-1 Dedicated Trunks	ES08	121
6.2.4 Wireless Network as Backup for 9-1-1 Dedicated Trunks	ES09	122
6.2.5 Intraoffice 9-1-1 Termination to Mobile PSAP	ES10	123
6.2.6 Backup PSAP in the LECs Serving Office	ES11	124
6.3 Defensive Measures for 9-1-1 Tandem Switches...		
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Table 6-1 NRC Essential Service Best Practices

Category	New Best	Former Best

	Practice No.	Practice No.
6.4 Reverse Trends toward Centralization	ES17	109
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6.7 Diverse ALI Data Base Systems	ES20	130
6.8 Mass Call Management...		
6.8.1 Move Mass Calling Stimulator away from 9-1-1 Tandem Switch	ES21	131
6.8.2 Pre-Planning for Mass Calling Events	ES22	132
6.9 Contingency Planning...		
6.9.1 Contingency Plan Development	ES23	133
6.9.2 Contingency Plan Training	ES24	134
6.9.3 Public Education on Proper Use of Essential Communications	ES25	135
6.10 Improve Communications among Network Providers and PSAPs	ES26	111
6.11 Common Channel Signaling (CCS)	ES27	110
6.12 Critical Response Link Redundancy/Diversity	ES28	New
6.13 Media and Repair Link Redundancy/Diversity	ES29	New
6.14 Private Switch/Alternative LEC ALI	ES30	New
6.15 CMRS - Emergency Calling	ES31	New
6.16 Cable Television Services	ES32	New
6.17 Outage Reporting	ES33	New

Table 6-1 NRC Essential Service Best Practices

Some of the best practices are alternate solutions for improving network reliability, and implementation of one practice may negate the need to implement another. For example, if one were to implement Best Practice ES03, it would not be necessary to implement Best Practice ES01 since the concept of facility route diversity is achieved in both practices.

6.1 Defensive Measures for Interoffice Facilities

Best Practices ES01 through ES05 describe practices that promote safeguarding of network facility paths between the callers end office and the PSAP.

6.1. Best Practice ES01 Diverse Interoffice Transport Facilities

When all 9-1-1 circuits are carried over a common interoffice facility route, the PSAP has increased exposure to possible service interruptions related to a single point of failure (e.g., cable cut). The ECOMM Team recommends diversification of 9-1-1 circuits over multiple, diverse interoffice facilities.

Diversification may be attained by placing half of the essential communication circuits on one facility route, and the other half over another geographically diverse facility route (i.e., separate facility routes). Many LECs deploy diverse interoffice facility strategies when diverse facilities are already available. (See Figure 6-1)

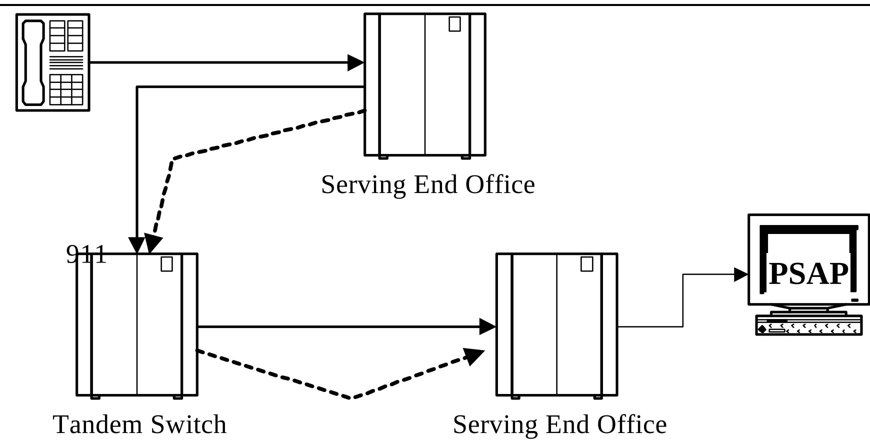

Figure 6-1 Interoffice Facility Architecture with Diversity

6.1.2 Best Practice ES02 Diverse Interoffice Transport Facilities with Standby Protection

A variation of the facility diversity architecture is deployment of a 1-by-1 facility transport system. This architecture is protected by a standby protection facility that is geographically diverse from the primary facility. Because no calls are lost while switching to the alternate transport facility during primary route failure, this architecture is considered self-healing.

6.1.3 Best Practice ES03 Diverse Interoffice Transport Facilities Using DCS

Earlier NRC Focus Group recommendations suggested using diverse interoffice transport facilities from the called serving end office via two diverse Digital Cross-connect Systems (DCS) for concentration. This approach provides diversity and, due to the concentration by the DCS network elements, offers a less costly network solution. Circuit rearrangement activity under this configuration will less likely result in the circuits being placed into non-diverse facilities. (See Figure 6-2)

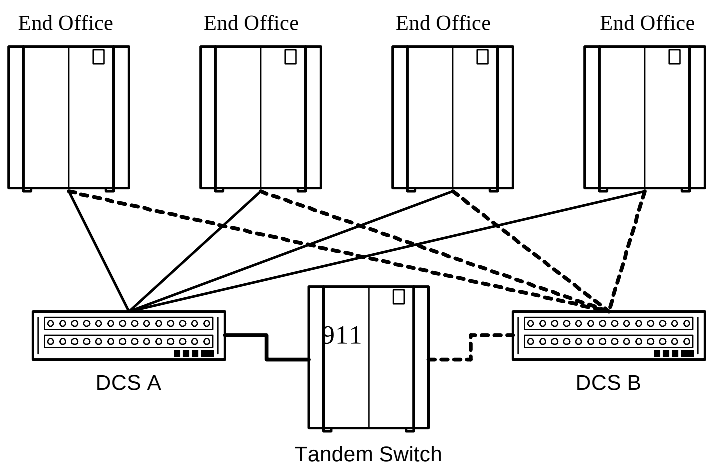

Figure 6-2 Interoffice Facility Architecture

6.1.4 Best Practice ES04 Fiber Ring Topologies for 9-1-1 Circuits

Fiber optic network elements offer network service providers the ability to aggregate large amounts of call traffic onto one transport facility. Traffic aggregation opposes the diverse facility transport recommendations defined in this document. However, fiber rings permit a collection of nodes to form a closed loop whereby each node is connected to two adjacent nodes via a duplex communications facility.

Fiber rings provide redundancy such that services may be automatically restored (self healing), allowing failure or degradation in a segment of the network without affecting service.
Fiber rings are used in some metropolitan areas, ensuring essential communications service is unaffected by cuts to fibers riding on the ring. Ring features and functionality are part of the Synchronous Optical Network (SONET) technical requirements. The ECOMM Team believes

when essential communications is placed on SONET rings, service interruptions are minimized due to the self-healing architecture employed. (See Figure 6-3)

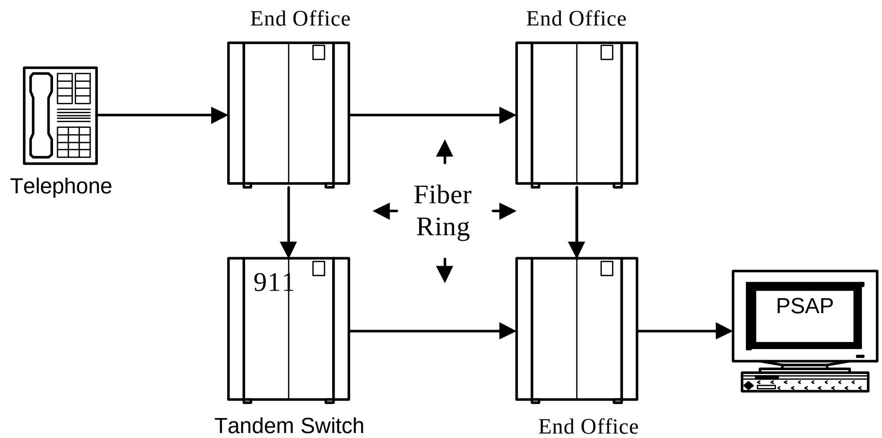

Figure 6-3 Interoffice Facility Architecture with Ring Diversity

6.1.5 Best Practice ES05 Red-Tagged Diverse Equipment

Depending on LEC provisioning practices, the equipment in the central office can represent single points of failure. The ECOMM Team supports the common LEC practice of spreading 9-1-1 circuits over similar pieces of equipment, and marking each plug-in-level component and frame termination with red tags. The red tags alert LEC maintenance personnel that the equipment is used for critical, essential services and is to be treated with a high level of care.

6.2 Alternate Path when the Primary 9-1-1 Interoffice Facility Fails

Best Practice ES06 through ES11 provide practices that promote establishment of alternate call paths between the caller's end office and the PSAP serving office.

6.2.1 Best Practice ES06 Alternate PSAPs from the 9-1-1 Tandem Switch

A common method of handling PSAP-to-Tandem transport facility interruptions is to program the 9-1-1 tandem switch for alternate route selection. If the 9-1-1 caller is unable to complete the call to the PSAP, the tandem switch would automatically complete the call to a pre-programmed directory number or alternate PSAP destination. The alternate PSAP may be either administrative telephones or another jurisdiction's PSAP positions, depending upon the primary PSAPs pre-arranged needs. (See Figure 6-4)

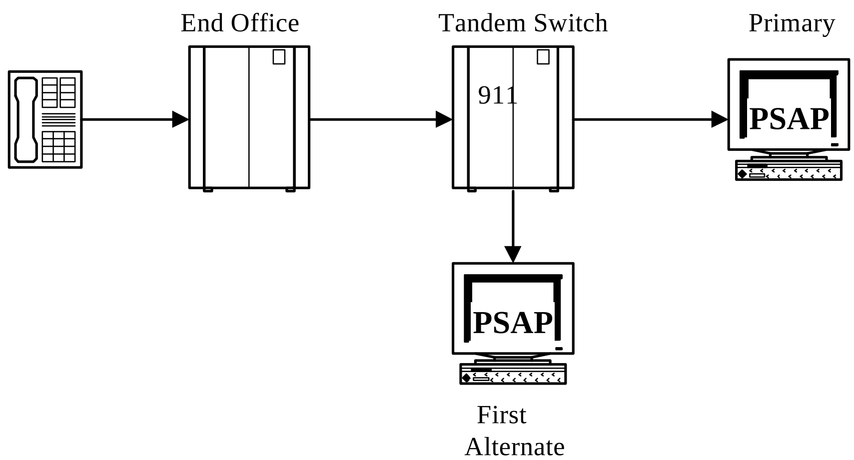

Figure 6-4 Alternate PSAP for Backup/Overflow

6.2.2 Best Practice ES07 Alternate PSAPs from the Serving End Office

Another method of handling PSAP-to-Tandem transport facility interruptions is to program the end office for alternate route selection. If the 9-1-1 caller is unable to complete the call to the PSAP, the end office switch may automatically complete the call to a pre-programmed directory number or alternate PSAP destination. The alternate PSAP may be either administrative telephones or another jurisdiction's PSAP positions, depending upon the primary PSAPs pre-arranged needs. (See Figure 6-5)

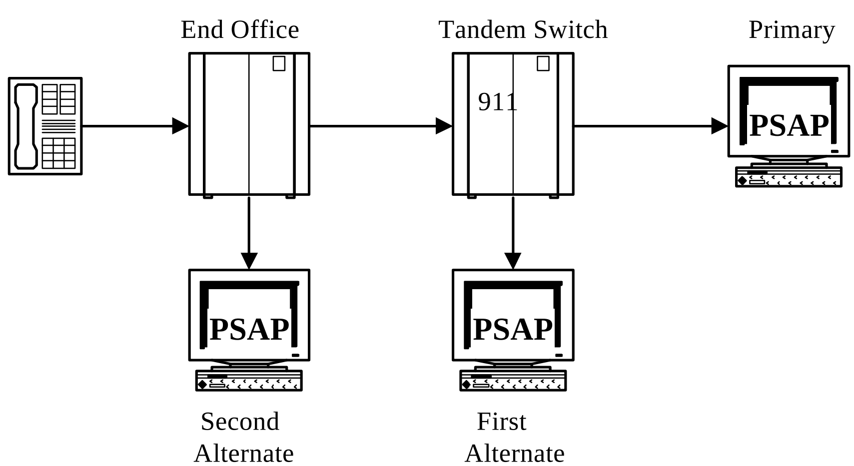

Figure 6-5 Alternate PSAP for Backup/Overflow

6.2.3 Best Practice ES08 PSTN as a Backup for 9-1-1 Dedicated Trunks

To ensure that 9-1-1 is minimally affected by potential traffic congestion sometimes experienced in the Public Switched Telephone Network (PSTN), PSAPs commonly create dedicated private public safety networks.

A low-cost alternative for handling 9-1-1 calls during periods of failure in the end office-to-9-1-1 tandem transport facility, is to use the PSTN as a backup between the caller's end office and the 9-1-1 tandem switch. Such applications may or may not make use of adjunct devices that monitor primary trunk path integrity.

If the primary path to the 9-1-1 tandem switch should be interrupted or all-trunks-busy, the call may be forwarded over the PSTN to a preprogrammed directory number. Further, the caller may be identified if the administrative line is equipped with a caller identification (ID) device. (See Figure 6-6)

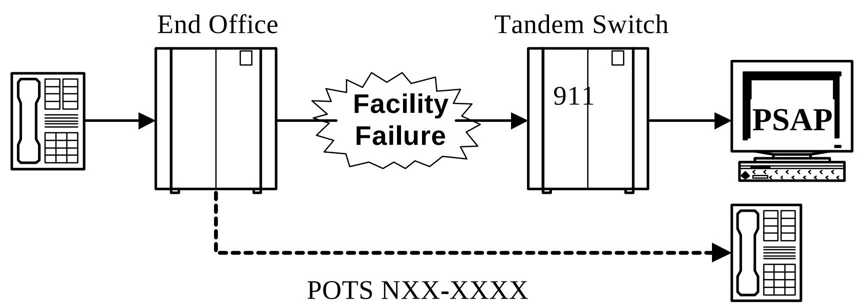

Figure 6-6 Diversity Through the PSTN

6.2.4 Best Practice ES09 Wireless Network as 9-1-1 Backup for 9-1-1 Dedicated Trunks

Similar to the PSTN backup for completing 9-1-1 calls when the primary transport facility is interrupted, wireless networks may provide more diversity than the PSTN alternative. (See Figure 6-7) As in Best Practice ES08, an adjunct device may or may not be used to monitor the primary trunk path integrity.

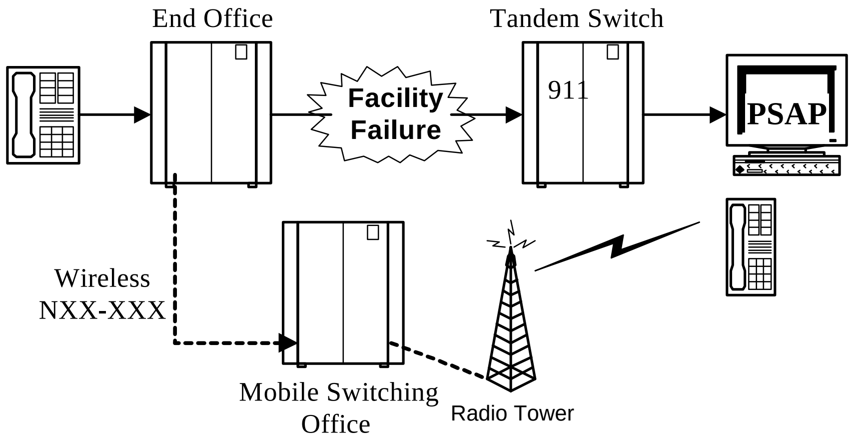

Figure 6-7 Diversity Through the Wireless Telephone Network

6.2.5 Best Practice ES10 Intraoffice 9-1-1 Termination to a Mobile PSAP

Commonly, the transport facility between the PSAP and the serving end office may not have facility route diversity. To accommodate instances where these facilities are interrupted or it becomes necessary to evacuate the PSAP location, some PSAPs have established mobile PSAP systems that may be connected to phone jacks at the serving end office. The phone jacks, although usually installed inside the end office for security purposes, are typically installed in an accessible location for ease in locating them during an emergency.

Some PSAPs have prearranged with the serving LEC to permit a jurisdictional employee having an emergency vehicle (e.g., police car) equipped with radio capability to retain a key to the LECs end office and to connect to an RJ-11 jack for 9-1-1 call interception. Another type of receptacle may be pre-installed in the end office for connection to a mobile PSAP. (See Figure 6-8)

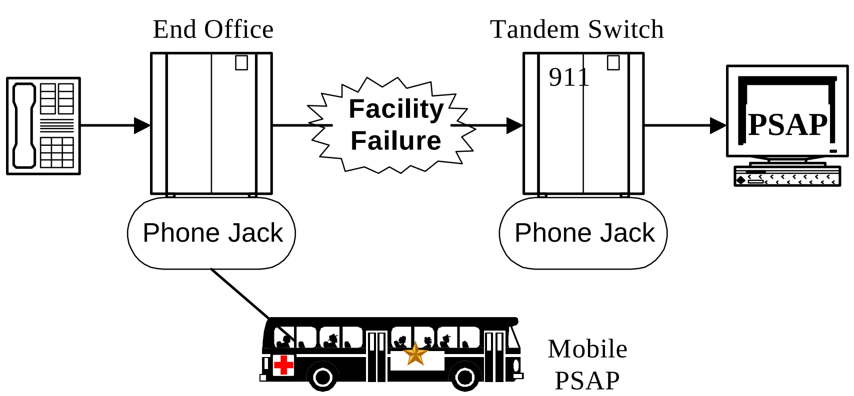

Figure 6-8 Diversity Through Intraoffice Call Termination

6.2.6 Best Practice ES11 Backup PSAP in the LECs Serving Office

Some PSAPs have also prearranged with the serving LEC to house a backup PSAP within the central office.

6.3 Defensive Measures for 9-1-1 Tandem Switches

Best Practices ES12 through ES16 describe practices that promote establishment of alternate tandem switching architectures.

6.3.1 Best Practice ES12 Dual Active 9-1-1 Tandem Switches

Dual active 9-1-1 tandem switch architectures enable circuits from the callers serving end office to be split between two tandem switches. Diverse interoffice transport facilities further enhance the reliability of the dual tandem arrangement. Diversity is also deployed on interoffice transport facilities connecting each 9-1-1 tandem to the PSAP serving end office. (See Figure 6-9)

Note: There are several ways to configure this architecture using multi-frequency and/or SS7 signaling. Based on one LEC's experience in attempting to implement this arrangement, extensive testing is strongly advised prior to implementation.

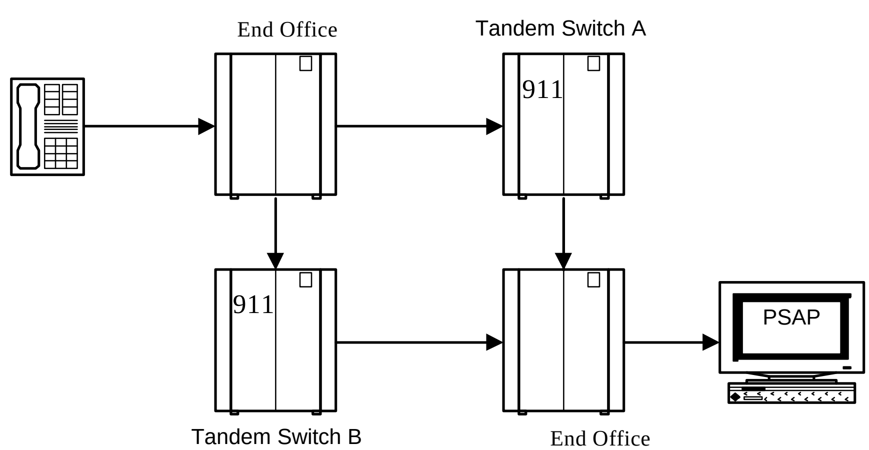

Figure 6-9 Interoffice Facility Architecture with Tandem Diversity

6.3.2 Best Practice ES13 Re-home to Backup 9-1-1 Tandem Switch

This architecture is similar to other 9-1-1 tandem switch architectures, but uses more than two 9-1-1 tandem switches. A primary 9-1-1 tandem handles a caller's serving end office's emergency calls until a fault occurs. Interoffice transport facility diversity is attained by splitting interoffice trunks between digital cross-connect systems.

PSAP circuits are also provisioned evenly across the 9-1-1 tandem switches, minimizing the single points for failure to occur. (See Figure 6-10)

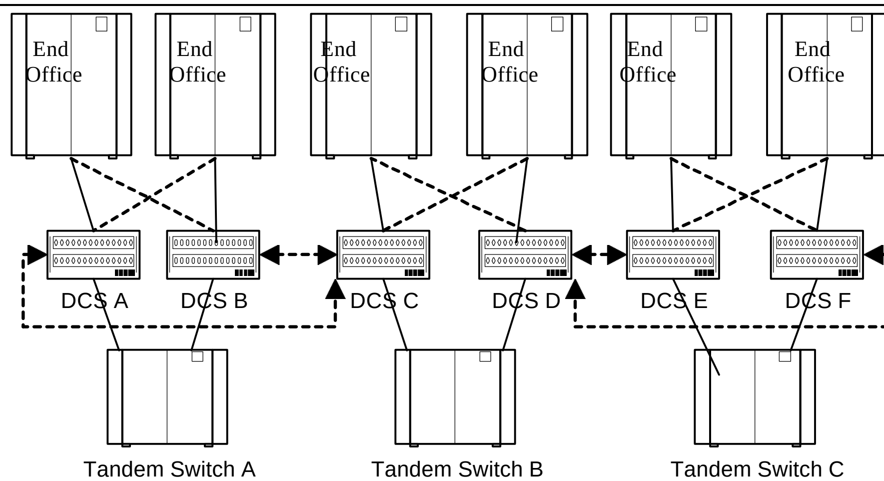

Figure 6-10 Interoffice Facility Architecture/Multiple Tandem Diversity

6.3.3 Best Practice ES14 Redundant Paired 9-1-1 Tandem Switches

In redundant/paired tandem switch applications, half of the 9-1-1 circuits are connected to each 9-1-1 tandem switch. If event call handling capabilities in one of the 9-1-1 tandem switches are interrupted, standard hunt group features in the caller's serving end office switch will select a call path via the other 9-1-1 tandem switch. Although the redundant/paired tandem configuration requires the complexity of maintaining identical routing data on both 9-1-1 tandem switches, the automated re-selection of an alternate call path enables call completion without manual intervention. Therefore, this network arrangement is more effective during momentary network failures.

6.3.4 Best Practice ES15 Multiple Diverse 9-1-1 Tandem Switches with Paired

Diverse DCSs

In a multiple tandem switch application, a backup tandem switch is available to handle 9-1-1 calling in the event the primary 9-1-1 tandem switch fails. Upon detection of failure of the primary 9-1-1 tandem, network controls may be activated by remote or local network surveillance forces that will steer 9-1-1 calling to the backup 9-1-1 tandem switch. Such steering may be accomplished through use of digital cross-connect elements available in many LEC end offices.

6.3.5 Best Practice ES16 TOPS as a 9-1-1 Tandem Backup

Operator services tandem switches can also serve as backup and/or overflow for network elements, due to their ubiquitous connectivity throughout the telephone network. In most instances, existing trunking and translations may be used when adding a Traffic Operator Position System (TOPS) to the 9-1-1 network.

When an interoffice transport facility fails or an all-trunks-busy condition occurs, the backup/overflow route to the operator services tandem is selected. The operator tandem switch recognizes the call as an emergency by translating the 9-1-1 dialed digits, and may be preprogrammed to automatically route the call to the serving 9-1-1 tandem switch.

Further, if the operator tandem switch is unable to access the 9-1-1 tandem switch, the call will automatically be “looped around” so that an operator may manually answer the call and manually attempt to reach emergency services providers. (See Figure 6-11)

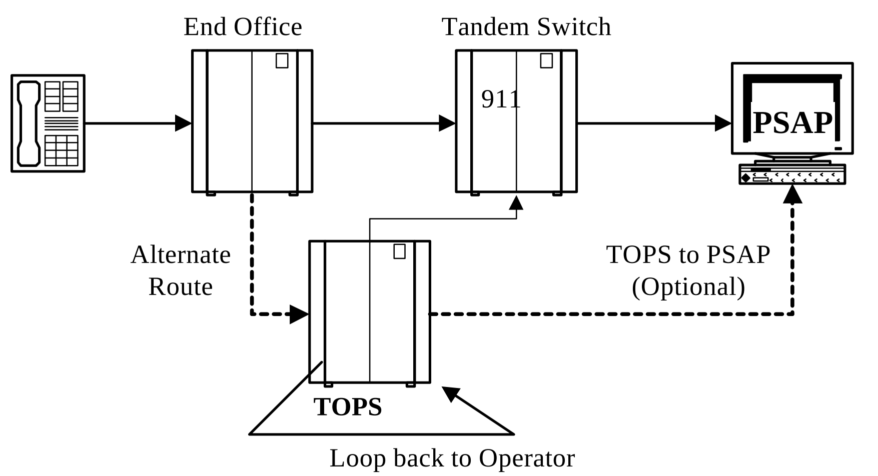

Figure 6-11 TOPS for Backup/Overflow

6.4 Best Practice ES17 Reverse Trends Toward Centralization

Network service providers should move to eliminate single points of failure in the interoffice facilities, 9-1-1 tandem switches and ALI data base portions of the public switched network. Measures include exploiting existing facility route diversity, reversing a trend towards concentration of large numbers of PSAPs on individual 9-1-1 tandem and deploying redundant, diverse ALI systems over diverse facilities.

Tandem switches used for 9-1-1 call routing are considered critical to a jurisdiction's ability to respond to emergency calls. Some of these switches connect over one million telephones, enabling access to the appropriate Public Safety Answering Point (PSAP).

Although the 9-1-1 tandem switches are usually deployed as redundant architectures, some software or procedural errors could interrupt the ability to complete the primary call path for 9-1-1 callers. To minimize the impact of such events, the ECOMM Team endorses deploying either multiple or redundant/paired tandem switches in 9-1-1 network architectures.

6.5 Best Practice ES18 Local Loop Diversity

The local loop access is defined as that portion of the network which connects the caller (i.e., the subscriber or the PSAP) to the network serving end office. The local loop is potentially a single point of failure.

Although it is unlikely the subscriber will purchase diverse transport facilities for typical PSTN service, the ECOMM Team recommends that PSAP local loops be diverse where possible and/or make use of wireless technologies as a backup for local loop facility failure (e.g., cable cuts).

6.6 Best Practice ES19 Network Management Center and Repair Priority

The ECOMM Team recommends that network management centers (NMCs) remotely monitor and manage the 9-1-1 network components. The NMCs should use network controls where technically feasible to quickly restore 9-1-1 service and provide priority repair during network failure events.

6.7 Best Practice ES20 Diverse ALI Data Base Systems

The ECOMM Team recommends that ALI systems be deployed in a redundant, geographically diverse fashion (i.e., two identical ALI data base systems with mirrored data located in geographically diverse locations).

Deployment of fully redundant ALI data base systems, such that ALI system hardware and/or software failure does not impair ALI data accessibility, will further improve ALI reliability. When deployed with geographically diverse transport facilities, single points of failure may be eliminated.

The NRC also recommends placement of the ALI data on fault-tolerant computer platforms to increase the reliability of ALI display retrievals. Finally, “hot spare” computers should be held in reserve for catastrophic events. (See Figure 6-12)

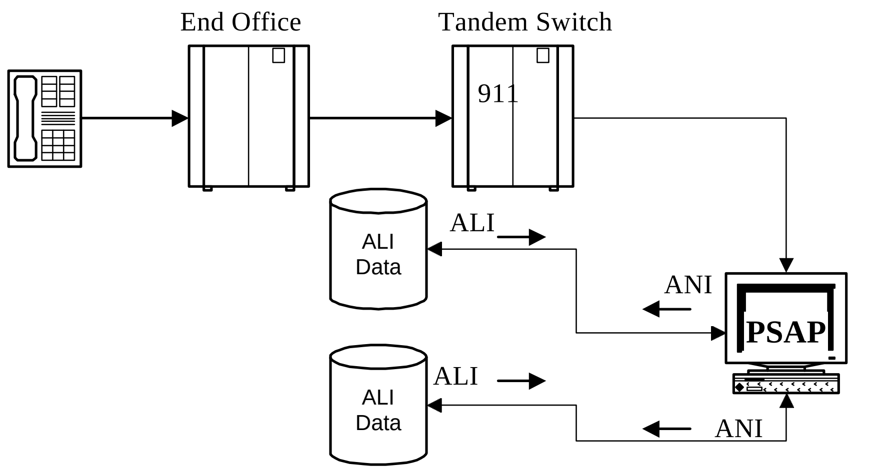

Figure 6-12 ALI Retrieval Architecture with ALI Diversity

6.8 Mass Call Management

Best Practice ES21 and ES22 provide practices that promote methods for controlling call volume and minimizing the impact of mass calling events.

6.8.1 Best Practice ES21 Move Mass Calling Stimulator away from 9-1-1 Tandem Switch

Mass calling events may cause 9-1-1 service interruptions. Service interruptions caused by media stimulated calling has prompted the LECs to reassess and improve the handling of mass calling events.

The 9-1-1 Tandem switch serves as the most critical network element in providing 9-1-1 service. If a media stimulated mass calling event is served by the 9-1-1 Tandem, the PSAPs being served by the 9-1-1 Tandem may experience delayed dial tone when call transfer is attempted by the PSAP personnel. The PSAP may also experience delays in call completion (ring-back tone) or a fast busy signal, which indicates that the call has failed to complete.

To mitigate such instances, the ECOMM Team recommends moving high volume call events to another end office or foreign exchange. (See Figure 6-13)

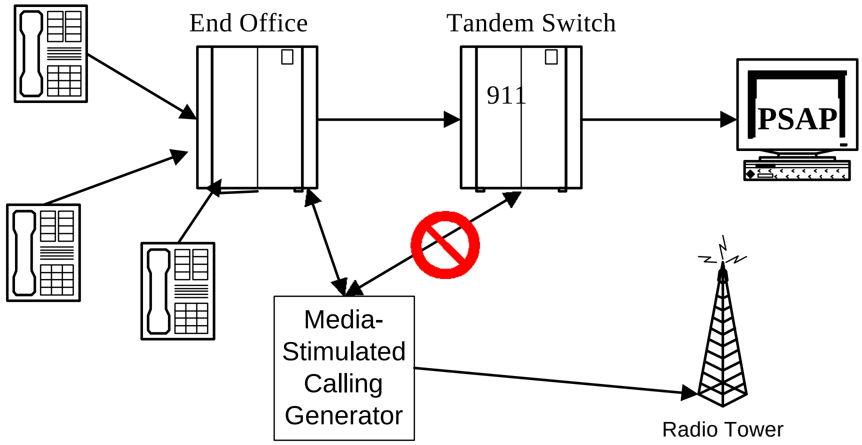

Figure 6-13 Media Stimulated Calling Architecture

6.8.2 Best Practice ES22 Pre-Planning for Mass Calling Events

To minimize the potential of interruption caused by media driven mass calling events, the LEC can identify periods of low call volume traffic so that the media may schedule mass calling events during low traffic periods.

The ECOMM Team supports such efforts by the LECs, and suggests that LEC external affairs and marketing groups work closely with media organizations to ensure 9-1-1 callers are unaffected by mass calling events.

6.9 Contingency Planning

Best Practices ES23 through ES25 describe practices that promote creation of contingency plans to minimize the effects of natural and man-made disasters and to ensure continuity in the provisioning of emergency services.

The ECOMM Team recommends that funding plans for 9-1-1 service include network reliability improvements and contingency plan development.

6.9.1 Best Practice ES23 Contingency Plan Development

Contingency plan development is the process of planning for recovery from a disaster that could impact the critical functions of a business operation. In broad terms, disaster recovery planning involves the following elements:

- Advance planning and arrangements necessary to ensure continuity of critical business functions.

- Making sufficient agreed-upon preparations and designing and implementing a sufficient set of agreed-upon procedures for responding to a disaster event.

- Implementing procedures that will either deter or reduce the business risk of previously identified threats.

- Developing a plan which covers events that could result in the total or partial loss of operational capability or destruction of a physical facility.

- Developing a plan which includes procedures and availability of critical equipment and personnel for both automated and manual functions.

The service provider (i.e., LEC, ATP, or CATV) has the responsibility to ensure continuity of service to the PSAP in the event of a disaster impacting their service delivering networks.

Some alternate technology providers have supplied their critical employees with portable computers, equipped with high speed modems, for them to remotely access switches. Critical employees are expected to work from a location that allows them access to the switches during times of emergencies/disasters.

Most alternate technology providers do not have a formal plan on where employees are to report for work if their primary work place is inaccessible, for whatever reason. Some alternate technology providers have indicated they are investigating this issue and that they intend to develop plans in the future.

PSAP administrators have responsibility for developing a plan to ensure continuity of 9-1-1 service in the event of a disaster which impairs the functionality of a PSAP. In so doing, PSAP administrators must evaluate and plan for response to a range of risks to PSAP functionality, including but not limited to:

- Loss of commercial power.

- Physical damage to the PSAP (natural or man-made disasters), including fire, earthquakes, etc.

- System software and hardware failures.

- Communication link failures (network redundancy and diversity issues).
- PSAP center evacuation and relocation of personnel.

With the current availability of alternate technologies, PSAP Administrators should more aggressively pursue use of these technologies during wireline network failures. However, it is critical that the alternative providers support and implement Enhanced 9-1-1 features equivalent to wireline ANI and ALI service.

PSAP Administrator contingency plans should include two-way radio as a last resort for handling essential communications during emergencies/disasters.

Wireline and wireless network providers should develop response capabilities to meet communications demands during large-scale emergencies/disasters. Plans should include, as a minimum, such topics as mutual aid agreements, NSEP issues, contact lists, and locations of critical equipment.

6.9.2 Best Practice ES24 Contingency Plan Training

Once a contingency plan is developed, it should be periodically tested. These tests can be of various types:

- Desktop check tests (using a check list to verify familiarity of "what to do in case of").
- Procedures verification test (verify that established procedures are followed in a simulation).
- Simulation test (similar to a fire drill, e.g., simulating a disaster and monitoring the response).
- Actual operations test (cause an event to happen, e.g., power or computer failure and monitor the response).

The importance of testing a contingency plan is critical to its success. An annual schedule of testing and evaluating written results is an excellent method of ensuring that a plan will work in the event of a disaster and for identifying weaknesses in the plan.

Close cooperation between a service provider and the PSAP in conducting actual operations testing will be of mutual benefit to both the service provider and the PSAP. An annual comprehensive operational test of the contingency plan is strongly encouraged.

6.9.3 Best Practice ES25 Public Education on Proper Use of Essential

Communications

The public's proper use of 9-1-1 service is critical to the effectiveness of the emergency network's operation. Misuse of 9-1-1 could lead to the following:

- Congestion of the 9-1-1 network, leaving callers with real emergencies unable to contact a 9-1-1 operator.

- Exhaustion of resources on non-emergency situations.

- Reduction in a jurisdiction's ability to respond to emergency situations in a timely manner because of the jurisdiction's emergency response agencies being overwhelmed by responses to non-emergency situations.

This could have potentially disastrous effects on the public's perception of its emergency network and emergency response agencies.

Consequently, there is a need for jurisdictions to educate their communities on the proper use of the 9-1-1 emergency network in order for the 9-1-1 network to remain viable. However, efforts by the networks to broadly advertise available services and proper use may actually yield negative and unintended results. The increased awareness by the public of 9-1-1 can lead to an increase in the volume of calls, a disproportionate number of which may be nuisance and non-emergency calls. One jurisdiction's solution to reducing the number of nuisance and non-emergency calls received by its 9-1-1 emergency network is defined below.

The Greater Harris County 9-1-1 Emergency Network, which serves the Houston, Texas, metropolitan area, used an approach that targets specific populations that may need further education on the proper use of 9-1-1 instead of conducting a large, broad-based public education campaign. The same approach may prove useful for other 9-1-1 jurisdictions that may be contemplating conducting public information campaigns.

To combat nuisance and hang-up calls received by the 9-1-1 emergency network, Greater Harris County 9-1-1 Emergency Network personnel analyzed the nuisance call data to see if they could recognize any trends. They discovered that many of the nuisance calls originated from coin-operated telephones located at schools and convenience stores. Corrective measures were then targeted at these locations, i.e., managers of convenience stores were encouraged to post signs warning juveniles that it was illegal to place non-emergency calls to 9-1-1, and school officials stationed teachers at coin-operated telephones at times when students were most likely to make hang-up calls to 9-1-1. These remedial efforts proved highly effective, significantly reducing the volume of nuisance calls from pay telephones. A significant point is that the reduction in nuisance calls was achieved without an expensive public information campaign, which might have inadvertently stimulated a disproportionate increase in non-emergency calls.

Based on its success with curbing nuisance calls, the Greater Harris County 9-1-1 Emergency Network decided to take a similar approach by educating segments of the community that are most likely to misuse the 9-1-1 network by an attempt to decrease the number of non-emergency calls that it receives.

Greater Harris County contracted with Rice University, Houston, Texas, to survey the Greater Harris County residents on how an individual's previous experience with the 9-1-1 emergency network and his or her ability to correctly identify emergency situations can influence an individual's use of the 9-1-1 network. The survey findings are being used to design and implement a public information campaign directed at eliminating the misuse of 9-1-1 services in Greater Harris County.

Rice University found that in Greater Harris County:

- The propensity to use 9-1-1 for non-emergencies seems much higher among certain demographic segments of the population, namely among certain racial/ethnic groups, particularly Blacks and Hispanics; younger residents; residents with lower incomes; and residents with less education.

- Within each racial or ethnic category, those individuals who had previously contacted 9-1-1 were much more likely to use 9-1-1 for non-emergency situations than was the general population.

- Most of those surveyed thought that the person seeking assistance through 9-1-1 should be the one to decide what constitutes an emergency, not the 9-1-1 network or operator.

- Anglos, particularly college-educated males, are significantly *less likely* than any other group in the community to seek assistance from either 9-1-1 or any other source when confronted with a medical emergency.

Based on the above findings, Rice University recommended that the Greater Harris County 9-1-1- Emergency Network conduct a public information campaign on the proper use of 9-1-1 that targeted specific ethnic and racial groups, rather than a broad-based public information campaign, because the survey did not uncover evidence that a misperception about 9-1-1 and its proper usage was either widespread or endemic to all segments of the community.

Some of the recommendations that were made for educating the targeted populations concerning 9-1-1 use include:

- Purchasing time slots on television and radio stations that are heavily watched by the targeted populations. Public service announcements should not be relied on because they may not reach the targeted populations.

- Extending the 9-1-1 Emergency Network's community outreach program to include contacts with neighborhood associations, churches, and other public and private organizations that have significant memberships from the targeted populations.

- Having network officials conduct a series of focus groups with representatives of each target population prior to implementing a public education campaign. The purpose of these sessions is to solicit reactions and opinions to the proposed education campaign from target group representatives.

- Conducting periodic surveys after each phase of the Network's public education campaign to evaluate the campaign's effectiveness.

The information that was gained from the Greater Harris County, Texas, surveys on the use of 9-1-1 among demographic segments of the population enabled Network officials to formulate a strategy for conducting a more effective public education campaign aimed at reducing the number of nuisance and non-emergency calls. The approach that was used and the information that was gained by the Greater Harris County 9-1-1 Emergency Network may provide insights for other communities on how to design 9-1-1 public education campaigns so that they target specific population segments in need of remedial education on the use of 9-1-1 emergency networks.

6.10 Best Practice ES26 Improve Communications among Network Providers and PSAPs

Network service providers, 9-1-1 administrators, and public safety agencies should continually strive to improve communications among themselves. They should routinely team to develop, review, and update disaster recovery plans for 9-1-1 disruption contingencies, share information about network and system reliability, and determine user preferences for call overflow routing conditions.

They should actively participate in industry forums and associations focused on improving the reliability of emergency services and the development of technical industry standards. The National Emergency Number Association (NENA) and the Association of Public-safety Communications Officials (APCO) are just two of the organizations that are open to all stakeholders of 9-1-1 service delivery and that are focused on finding 9-1-1 solutions for emerging technologies (e.g., wireless, PBX, ALEC).

6.11 Best Practice ES27 Common Channel Signaling (CCS)

The ECOMM Team considers all of the Best Practices formerly defined by the earlier NRC effort as still being valid, with the exception of the former NRC recommendation to avoid use of the 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.

Further, telecommunication standards bodies are exploring creation of SS7 compatible data packets for passing caller location and other wireless information detail to Integrated Services Digital Network (ISDN) PSAPs.

6.12 Best Practice ES28 Critical Response Link Redundancy/Diversity

The ECOMM Team recommends that the redundancy and diversity concepts set forth in section 6.1 (Defensive Measures for Interoffice Facilities) be applied to other network links considered vital to a community's ability to respond to emergencies. Types of links that are critical to the provision of emergency aid include communication links from the PSAP location to:

- Law enforcement dispatchers and/or response personnel.
- Emergency medical service (EMS) dispatchers and ambulance response units.
- Fire fighter dispatchers and response personnel.

  Poison control centers and other agencies offering remote diagnostic information and advice on how to respond to requests for emergency aid.

- Trauma centers and similar emergency hospices.

Standards must be established to address interconnection issues between PSAP and CMRS/cable television service providers.

6.13 Best Practice ES29 Media and Repair Link Redundancy/Diversity

The ECOMM Team recommends that the redundancy and diversity concepts set forth in section 6.1 (Defensive Measures for Interoffice Facilities) be applied to network links considered vital to a community's ability to respond to emergencies. Types of links that are critical to the provision of emergency aid during such events include communication links from the PSAP location to broadcast media organizations and local network provider repair centers.

Media organizations can alert the public during periods of emergency network degradation or outage through appropriately worded public service announcements, relieving excessive call volumes, and making the public aware of interim emergency aid access alternatives.

In addition, dedicated network links and/or alternate accesses to network provider repair personnel will ensure that interruptions are known immediately and that repair personnel are mobilized expeditiously.

6.14 Best Practice ES30 Private Switch/Alternative LEC ALI

The ECOMM Team supports inclusion of ALI data for alternate providers (PSALI, ALEC ALI, etc.) in the ALI systems, and urges the FCC to aggressively pursue closure on those issues remaining for Docket 94-102, and to require affected service providers to participate in PSAP PSALI programs.

PSAPs have become increasingly reliant on the ALI data administered by the LECs, and believe that those individuals served by private telecommunication providers and/or alternate LEC providers should have their address information contained in their ALI data base systems. The *NENA Recommended Formats for Data Exchange* and the *NENA Recommended Protocols for Data Exchange* were established to enable ALI data integration of these providers.

6. 15 Best Practice ES31 CMRS - Emergency Calling

The ECOMM Team recommends that the CMRS industry consider 9-1-1 as the standard access code for emergency services, such as law enforcement, fire, EMS. Implementation of such a standard would eliminate confusion among mobile communications users when they are in a roaming mode.

6. 16 Best Practice ES32 Cable Television Services

The cable television industry has published a document titled *NCTA Recommended Practices for Measurement on Cable Television Systems*. This document is available from NCTA. The document is technically oriented for systems engineers.

Based on information obtained from NCTA, the ECOMM Team recommends that the NCTA document form the basis for cable television services best practices. This will create a more reliable environment for all services, including emergency communications.

6.17 Best Practice ES33 Outage Reporting

The ECOMM Team recommends that all providers of essential communications have a uniform method of reporting and tracking significant service outages for internal use and, where required, for outage reporting to the FCC. Root cause analysis, publication of results and new best practices may be left up to the industry.

7. Metrics

The telecommunications industry uses a number of tools to measure network reliability. Initially, the NRSC used outage frequency tracked over time as an indication of network performance. However, simple outage counts can provide an incomplete measure of network performance in that all outages are counted equally, even though a very large outage has more impact on the public than an outage that just barely meets the reporting threshold criteria. The T1A1.2 Working Group developed a metric, called an “Outage Index”, that provides a measure of the relative importance of outages for different services with respect to their publicly perceived impact.

The ECOMM Team recommends that Committee T1, specifically T1A1.2 Working Group, should consider enhancing the outage index to include services provided by cellular, satellite, and cable industries. Once developed, individual companies can apply this measure internally to their outage data to assess network reliability performance.

Further, the ECOMM Team urges all parties involved in public safety telecommunications to actively participate in quality assurance tracking programs currently being developed by NENA standards committees, and to perform root cause analysis and tracking of outages.

8. Path Forward

8.1 Introduction

Public safety communication networks are in a dynamic environment with numerous emerging technologies continually posing new challenges and opportunities. The key to reliable and effective emergency communications is partnering between telecommunication standards setting organizations, the telecommunications industry, equipment manufacturers, and the public safety community.

Public safety associations like NENA and APCO have evolved into premier representative organizations for interfacing with telecommunications associations like the Telecommunications Industry Association (TIA), Cellular Telecommunications Industry Association (CTIA), United States Telephone Association (USTA), and others. The ECOMM Team supports fostering cooperative relationships among these organizations, and believes continued teaming between these organizations will provide comprehensive solutions to ensuring network reliability. The ECOMM Team also supports the establishment of industry standards to ensure selective routing processes are adequate to handle essential communications.

The ECOMM Team identified the following topics as being areas for any future study because they could:

- Impact the reliability of 9-1-1 and other essential telecommunications.

- Provide insight into how a jurisdiction could more effectively undertake a public education campaign on the proper use of 9-1-1 and other essential telecommunications so that the desired results are achieved.

- Advance the reliability of essential telecommunications by using proven methodologies for comprehensively assessing the reliability and security of telecommunications networks, software, data bases, and physical installations and assets. Once vulnerabilities or weaknesses have been identified for a telecommunications system, countermeasures can be formulated which, when implemented, would effectively mitigate the vulnerabilities.

- Provide insight and lessons learned on how to prepare more effective questionnaires that would more adequately elicit information concerning essential communications reliability from organizations that provide those essential communications.

As a minimum, the ECOMM Team believes that any future effort to study essential communications reliability should solicit information from wireline and wireless network service providers and PSAPs on the following:

- Which Best Practices they are currently using

- Which Best Practices they are planning to use

- Which Best Practices they are not using, and why

- Which Best Practices they considered to be obsolete due to technological advances

- Which localized practices they have found to be particularly effective or noteworthy, and which should be considered for recommendation as Best Practices across the essential communications industry.

The study effort could be undertaken by a team consisting of members from across the telecommunications industry who have a stake in essential telecommunications, including wireline telecommunications providers; wireless telecommunications providers; Federal and State government agencies; professional industry organizations such as the National Emergency Number Association (NENA), the National Association of Nine-one-one Administrators (NASNA), and the Association of Public-safety Communications Officials (APCO); and organizations with expertise in the use of reliability and risk assessment methodologies.

8.2 Lessons Learned on Questionnaire Preparation and Distribution

8.2.1 Time Required for Questionnaire Development

Although the ECOMM Team spent considerable time, both as a team and individually, developing and commenting on the draft questionnaires, allowing sufficient time up front for questionnaire development cannot be overemphasized. We also recommend consulting with someone who is knowledgeable and experienced in the preparation of questionnaires since the wording of the questionnaire can greatly influence, or even skew, the responses that are obtained. For example, Question ID 110 in the Best Practices Questionnaire (see Exhibit E2) on the use of CCS for 9-1-1 telecommunications was stated in terms of <u>deferring</u> a practice while the other questions were stated in terms of <u>implementing</u> a practice. This kind of inconsistency can confuse respondents.

8.2.2 Neutral Responses to Questions

Questions should be designed so that they always have a neutral response option such as "not applicable," "unknown," or "do not know." By so doing, the respondent does not feel forced to answer a question if he or she does not have an answer. Also, it may reduce the number of written comments which are often difficult to interpret, categorize, and quantify statistically.

8.2.3 Prototyping the Questionnaire

Once a questionnaire is developed, sufficient time should be scheduled into the data collection process to allow the questionnaire to be sent to a small sample of the respondents before the questionnaire is sent to the entire respondent population. This enables the group soliciting the data to validate the understanding of the questionnaire by the respondents and the effectiveness of the questionnaire in soliciting the desired data and responses. At this stage, if the questionnaire is not effectively soliciting the desired information, it can be modified to improve its effectiveness before it is sent to the entire respondent population.

8.2.4 Questionnaire Respondents

Questionnaires should be addressed to specific people in key positions who have overall responsibility for administering or implementing essential communications (e.g., the person in charge of essential telecommunications implementation for a network service providers, or the PSAP administrator for the PSAP) so that people who are knowledgeable about the network are responding to the questionnaire. This will allow more consistent information to be obtained from respondents who truly understand the reliability issues associated with essential communications.

8.2.5 Increasing Questionnaire Responses

The ECOMM Team found that the number of questionnaires returned was greatly increased by including a pre-addressed envelope with each questionnaire. The questionnaires also should be printed *single-sided* to increase the likelihood that all of the questions are answered and to decrease the potential of losing information if the respondent chooses to return the information by facsimile.

8.2.6 Technical Information about Essential Communications Network Configurations

Because of the rapidly changing technology development and deployment associated with essential communications networks, the ECOMM Team found it best to consult directly with the network service providers to obtain technical information about the equipment being used; whether the equipment is single, redundant, or diverse; and where the equipment is located (e.g., ALI databases) for a specific jurisdiction.

8.3 Emerging Technologies

The ECOMM Team has identified the following emerging technologies as having a potential impact on emergency communications, and believes that any future study efforts should include analysis of:

- AIN (Advanced Intelligent Network)
- SONET (Synchronous Optical Network)
- ATM (Asynchronous Transfer Mode)
- Private switch providers
- ALECs (Alternative Local Exchange Carriers)
- Network resale
- ALI data out sourcing
- Number portability
- Wireless, including Wireless Location Identification.

Contact your local service provider for detailed descriptions of these services and how they may impact emergency communications.

9. Acknowledgments

The ECOMM Team wishes to thank the following people and organizations for their generous contributions to this study effort:

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- Dr. William Munn, Tarrant County 9-1-1 Director, Tarrant County, Texas for his presentation on Contingency Planning for Disasters;
- Dean Robert M. Stein, Rice University for Policy Analysis, Rice University, Houston, Texas, and Ms. Sonya Lopez, Public Information Director, Greater Harris County 9-1-1 Emergency Network, Houston, Texas, for the information that they shared with the ECOMM Team on their research for conducting 9-1-1 public education campaigns which is summarized in Section 6.9.3 of this report;
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- The National Emergency Number Association (NENA) for providing the ECOMM Team with mailing labels from their distribution list of over 5,000 Public Safety Answering Points, which greatly helped in the mailing of the PSAP questionnaires.

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11. Glossary of Terms and Abbreviations

Term/Abbreviation	**Definition**
911	National telephone number established to reach emergency assistance.
911 Tandem Switch	A switch that performs selective 911 call routing to the assigned Primary PSAP, based on the caller's number and/or serving end office. It also permits fixed or selective call transfers.

AC	Alternating Current Power
ACD	Automatic Call Distributor
AIN	Advanced Intelligent Network
ALEC	Alternative Local Exchange Carrier
ALI	Automatic Location Identification - Address and dispatch information associated with the calling party.
ALI System	The host computer system which stores the ALI records.
Alternate PSAP	A PSAP designated to receive calls when the primary PSAP is unable to do so.
ANI	Automatic Number Identification - Telephone number associated with the calling party.
APCO	Association of Public-safety Communications Officials
ATM	Asynchronous Transfer Module
ATP	Alternate Technology Provider
AVL	Automatic Vehicle Location
CAD	Computer Aided Dispatch - An optional computer-based system which presents enhanced caller identification information and dispatch options to the PSAP call attendant.
CAMA	Centralized Automatic Message Accounting - Trunking capable of forwarding the ANI of the calling party.
CAP	Competitive Access Provider
CATV	Cable Television
CCS	Common Channel Signaling - a network that enables signaling data to be carried over a different path than the voice path. A specific type of CCS is SS7.
CG	Coast Guard
CLEC	Competitive Local Exchange Carrier
CMRS	Commercial Mobile Radio Services - Includes cellular, PCS, etc.
CO	Central Office - The telephone company facility where subscriber lines are joined to switching equipment for connection to other subscribers.
COW	Cellular On Wheels
Term/Abbreviation	**Definition**
CPAS	Cellular Priority Access Services
CPE	Customer Premise Equipment
CTIA	Cellular Telecommunications Industry Association
DCE	Data Communications Equipment
DCS	Digital Cross-connect System
DMARC	The point or location in the network where the service provider terminates its services.
Diverse/Diversity	Duplication of components and/or trunk facilities, running in geographically different locations and/or over geographically

	separate paths.
DTE	Data Terminal Equipment
DUI	Driving Under the Influence
E911	Enhanced 911 - enables display of ALI to the PSAP during a 911 call.
ECOMM Team	Emergency Communications During Disasters Team - Network Reliability Council's Focus Group IV.
Emergency Services	Fire, Police, EMS, Trauma Centers, Poison Control Centers, etc.
EMD	Emergency Medical Dispatch
EMS	Emergency Medical Services
ESMR	Enhanced Specialized Mobile Radio
Essential Communications	Those connections considered vital to the delivery of emergency response and aid during routine or disaster periods.
FCC	Federal Communications Commission
GETS	Government Emergency Telephone Service
GIS	Geographic Information System
HP	Highway Patrol
IC	Interexchange Carrier - A long distance service provider.
Interexchange	Facilities and/or trunking between two separate Central Offices.
Intraexchange	Facilities and/or trunking within the same Central Office.
InterLATA	Facilities and/or trunking between two separate Local Access Transport Areas.
IntraLATA	Facilities and/or trunking within the same Local Access Transport Area.
ID	Identification
ISDN	Integrated Services Digital Network
Jurisdiction	A geographic area assigned to a set of governmental bodies responsible for delivery of emergency aid.
LEC	Local Exchange Carrier - A local service provider
Link	A fixed network facility connection.
Term/Abbreviation	**Definition**
MDT	Mobile Display Terminal
MHz	Megahertz, or one million hertz - A frequency measurement associated with signal transmission.
MIS	Management Information System - A program that collects, stores, and collates data into reports enabling interpretation and evaluation of performance, trends, traffic capacities, etc.
MSA	Metropolitan Statistical Area
MSS	Mobile Satellite Services
Mutual Aid Agreements	Agreements made between multiple jurisdictions for backing up each other for purposes of 911 call taking and/or delivery

	of emergency aid.
NASNA	National Association of State Nine-one-one Administrators
NCS	National Communications System
NCTA	National Cable Television Association
NENA	National Emergency Number Association
NNX or NXX	The first 3 digits of a 7-digit telephone number in the North American Numbering Plan.
NMC	Network Management Center
NPA	Numbering Plan Area - Commonly known as the area code, it is the first 3 digits of a 10 digit telephone number.
NPD	Numbering Plan Digit - Specifies the NPA code value for ANI displays accommodating only 8 digits.
NRC	Network Reliability Council
NRSC	Network Reliability Steering Committee
NSEP	National Section of Emergency Preparedness
NSTAC	National Security Telecommunications Advisory Committee
OMNCS	Office of the Manager, National Communications System
PACA	Priority Access Channel Assignment
PBX	Private Branch Exchange
PCS	Personal Communications Services
PIN	Personal Identification Number
Primary PSAP	The first choice PSAP to which a 911 call is routed from the Central Office under normal conditions.
PSALI	Private Switch Automatic Location Identification
PSAP	Public Safety Answering Point - A centralized location for receiving 911 calls.
Pseudo ANI	A fictitious ANI passed to a PSAP for general location identification of the calling party.
PSTN	Public Switched Telephone Network
Redundant/Redundancy	Duplication of components and/or trunk facilities, running in parallel.
Term/Abbreviation	**Definition**
Secondary PSAP	A PSAP to which 911 calls are transferred after being screened for service needs by the Primary PSAP.
SONET	Synchronous Optical Network
SOW	Switch On Wheels
SPOC	Single Point Of Contact
SRS	Selective Routing System - Performs selective call routing to the assigned Primary PSAP, based on the calling parties number and/or central office. It also permits fixed or selective call transfers.
SS7	A specific type of CCS network used by many of the LECs.
TDD	Telecommunications for the Deaf Devices - Permit

	communications at the PSAP for hearing impaired callers.
TIA	Telecommunications Industry Association
TOPS	Traffic Operator Position System
Trunk	The communication path, or channel, between central offices, or central offices and private switching devices.
TSP	Telecommunications Service Priority - Establishes priority of circuit restoration during service interruptions.
UPS	Uninterruptible Power Supply - An auxiliary power unit for a telephone system which provides continuous battery backup power in the event of a commercial power failure.
USTA	United States Telephone Association
WAN	Wide Area Network
WSP	Wireless Service Provider

Exhibit E-1   Companies Responding to the ECOMM Team Surveys

Type	Company Name	Returned Data to E911
IC	AT&T Network Services	Y
IC	MCI Communications Corporation	Y
IC	Sprint Corporation	Y
IC	Cable & Wireless, Inc.	Y
IC	Worldcom Corporation	Y
IC	Teleport Communications Group	N
LEC	NYNEX Corporation	Y
LEC	Pacific Telesis	Y
LEC	U S WEST Communications	Y
LEC	Ameritech	Y
LEC	GTE Corporation	Y
LEC	BellSouth Telecommunications	Y
LEC	Bell Atlantic Network Services, Inc.	Y
LEC	Southwestern Bell Telephone Company	Y
LEC	Frontier Corporation	Y
LEC	Lincoln Telephone & Telegraph	Y
LEC	Southern New England Telephone	Y
LEC	Sprint Corporation - Local Phone Division	Y
Wireless	AT&T Wireless Services, Inc.	Y
Wireless	Southwestern Bell Mobile Systems	N
Wireless	GTE Mobilnet	Y
Wireless	BellSouth Cellular Corp.	Y
Wireless	Bell Atlantic Mobile Systems, Inc.	Y
Wireless	AirTouch Communications	Y
Wireless	Ameritech Mobile Communications, Inc.	Y
Wireless	Sprint Cellular	Y
Wireless	U S West NewVector Group, Inc.	Y
Wireless	NYNEX Mobile Communications	Y
Wireless	Comcast Cellular Communications, Inc	Y
Wireless	ALLTEL Mobile Communications, Inc.	Y
Wireless	United States Cellular	Y
Wireless	Century Cellunet, Inc	Y
Wireless	SNET Mobility, Inc.	Y
Wireless	CommNet Cellular, Inc.	Y

Exhibit E-1   Companies Responding to the ECOMM Team Surveys (cont.)

Type	Company Name	Returned Data to E911
Cable	Cablevision Industries Corporation	N
Cable	Adelphia Communications	N
Cable	Jones Intercable, Inc	N
Cable	Viacom Cable	N
Cable	Falcon Cable TV	N
Cable	Time Warner Cable	N
Cable	Continental Cablevision	N
Cable	Comcast Cable	N
Cable	Cox Communications, Inc.	N
Satellite	AT&T SKYNET Satellite Services	Y
Satellite	COMSAT Corporation	Y
Satellite	Hughes Communications, Inc.	Y
Satellite	GE American Communications, Inc.	Y
Satellite	Alascom, Inc.	Y
Satellite	General Communications, Inc.	Y
Satellite	American Mobile Satellite Systems	Y
Satellite	IRIDIUM, Inc	Y
Satellite	Globalstar LP	N
CAP	ICG Access Services	Y

Exhibit E-2 E9-1-1 Portion of the NRC Best Practices Questionnaire for Service Providers

ID	Focus Team	Recommendation	June 1993 Report Reference	Categories: Obsolete? (Y -Yes Blank -No)	Categories: Relative Cost to Implement (VL, L, M, H, VH)	Implementation: Implemented (F-Fully, P-Partially N-Not)	Implementation: Planned (Y,N)	Implementation: Alternate Solution (Y,N)	Value: Effectiveness Rating (1- 5) (0-Don't Know)
Please answer the questions on the following 911 best practices as applied in metropolitan areas. (Non-metropolitan application is addressed below.)									
109	E911	Evaluate Trend toward Increased Concentration of 911 Capabilities	F-1.3, 6.2						
110	E911	Defer Use of CCS Network Until Protocol Issues Addressed by Standards Bodies	F-1.3, 6.7						
111	E911	Improve Communications Among LECs, Administrators & Public Safety Agencies	F-1.3						
112	E911	50% of 911 Circuits Provisioned on Each of Two Diverse Interoffice Facilities	F-6.1.1, Fig. 6-2						
113	E911	Automatic Switching of 911 Circuits to a Diverse Standby Protection Facility	F-6.1.1						
114	E911	Diverse Interoffice Facilities from Customer End Office Home onto Two Diverse DCSs	F-6.1.1, Fig. 6-3						
115	E911	Fiber Ring Topologies for 911 Circuits	F-6.1.1.1, Fig. 6-4						
116	E911	Two 911 Tandems to Serve a Single Customer and the PSAP	F-6.1.2.1, 6.2.1, Fig. 6-5						
117	E911	Re-homing to Back-up 911 Tandem Switch	F-6.1.2.2, 6.2.2, Fig. 6-6						
118	E911	Alternate PSAPs off the 911 Tandem Switch	F-6.1.3.1, Fig. 6-7						
119	E911	Alternate PSAPs off the End Office	F-6.1.3.1, Fig. 6-7						
120	E911	Operator Services Tandem as Backup for 911	F-6.1.3.2, Fig. 6-8						
121	E911	Public Switched Network as Back-up for 911 Dedicated Trunks	F-6.1.3.3, Fig. 6-9						
122	E911	Cellular Network as Back-up	F-6.1.3.4, Fig. 6-10						

Exhibit E-2 E9-1-1 Portion of the NRC Best Practices Questionnaire for Service Providers

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123	E911	Intraoffice Call Termination to Mobile PSAP when Office is Isolated	F-6.1.3.5, Fig.6-11						
124	E911	Back-up PSAP Permanently Located Within the Central Office	F-6.1.3.5						
125	E911	Red-tagged, Diverse Equipment within a Central Office	F-6.1.4						
126	E911	Diverse Paired 911 Tandem Switches	F-6.2.1						
127	E911	Multiple Diverse 911 Tandem Switches with Paired Diverse DCSs	F-6.2.2, Fig. 6-6						
128	E911	Local Loop Diversity for Larger PSAPs	F-6.3						
129	E911	911 Network Management Center & Procedures to Manage and Prioritize Repairs	F-6.4						
130	E911	Diverse ALI Database Systems	F-6.5, Fig. 6-14						
131	E911	Move Mass Calling Stimulator Away from 911 Tandem Switch	F-6.6, Fig. 6-15						
132	E911	Pre-planning and Cooperation to Minimize Effects of Mass Calling Events	F-6.6						
133	E911	Contingency Plan Development for Emergency 911 Service	F-6.7.1						
134	E911	Contingency Plan Training for Emergency 911 Service	F-6.7.1						
135	E911	Public Education on Proper Use of 911 Service	F-6.7.1						
	Please answer the same questions on the 911 best practices as applied in non-metropolitan areas.								
109	E911	Evaluate Trend toward Increased Concentration of 911 Capabilities	F-1.3, 6.2						
110	E911	Defer Use of CCS Network Until Protocol Issues Addressed by Standards Bodies	F-1.3, 6.7						

Exhibit E-2 E9-1-1 Portion of the NRC Best Practices Questionnaire for Service Providers

ID	Focus Team	Recommendation	June 1993 Report Reference	Categories: Obsolete? (Y -Yes Blank -No)	Categories: Relative Cost to Implement (VL, L, M, H, VH)	Implementation: Implemented (F-Fully, P-Partially N-Not)	Implementation: Planned (Y,N)	Implementation: Alternate Solution (Y,N)	Value: Effectiveness Rating (1- 5) (0-Don't Know)
111	E911	Improve Communications Among LECs, Administrators & Public Safety Agencies	F-1.3						
112	E911	50% of 911 Circuits Provisioned on Each of Two Diverse Interoffice Facilities	F-6.1.1, Fig. 6-2						
113	E911	Automatic Switching of 911 Circuits to a Diverse Standby Protection Facility	F-6.1.1						
114	E911	Diverse Interoffice Facilities from Customer End Office Home onto Two Diverse DCSs	F-6.1.1, Fig. 6-3						
115	E911	Fiber Ring Topologies for 911 Circuits	F-6.1.1.1, Fig. 6-4						
116	E911	Two 911 Tandems to Serve a Single Customer and the PSAP	F-6.1.2.1, 6.2.1, Fig. 6-5						
117	E911	Re-homing to Back-up 911 Tandem Switch	F-6.1.2.2, 6.2.2, Fig. 6-6						
118	E911	Alternate PSAPs off the 911 Tandem Switch	F-6.1.3.1, Fig. 6-7						
119	E911	Alternate PSAPs off the End Office	F-6.1.3.1, Fig. 6-7						
120	E911	Operator Services Tandem as Backup for 911	F-6.1.3.2, Fig. 6-8						
121	E911	Public Switched Network as Back-up for 911 Dedicated Trunks	F-6.1.3.3, Fig. 6-9						
122	E911	Cellular Network as Back-up	F-6.1.3.4, Fig. 6-10						
123	E911	Intraoffice Call Termination to Mobile PSAP when Office is Isolated	F-6.1.3.5, Fig.6-11						
124	E911	Back-up PSAP Permanently Located Within the Central Office	F-6.1.3.5						
125	E911	Red-tagged, Diverse Equipment within a Central Office	F-6.1.4						
126	E911	Diverse Paired 911 Tandem Switches	F-6.2.1						

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127	E911	Multiple Diverse 911 Tandem Switches with Paired Diverse DCSs	F-6.2.2, Fig. 6-6						
128	E911	Local Loop Diversity for Larger PSAPs	F-6.3						
129	E911	911 Network Management Center & Procedures to Manage and Prioritize Repairs	F-6.4						
130	E911	Diverse ALI Database Systems	F-6.5, Fig. 6-14						
131	E911	Move Mass Calling Stimulator Away from 911 Tandem Switch	F-6.6, Fig. 6-15						
132	E911	Pre-planning and Cooperation to Minimize Effects of Mass Calling Events	F-6.6						
133	E911	Contingency Plan Development for Emergency 911 Service	F-6.7.1						
134	E911	Contingency Plan Training for Emergency 911 Service	F-6.7.1						
135	E911	Public Education on Proper Use of 911 Service	F-6.7.1						

Exhibit E-3

Questionnaire for Public Safety Answering Point (PSAP) Information

(To be filled in by each PSAP in the survey.)

1. Is your PSAP in a (check one): _____Metro Area _____Non-Metro Area?
2. Do you have a single link, 2 redundant links-but not diverse (same facility route), 2 diverse links (2 separate facility routes), or no link for each of the following connections? (check one)

Connection	Single Link	2 Redundant Links	2 Diverse Links	No Link
PSAP access to links which access ALI database				
PSAP access to local law enforcement dispatch				
PSAP access to EMS dispatch or EMS/Fire Combined				
PSAP access to Fire Department				
PSAP access to Poison Control Center				
PSAP access to Trauma Center (or hospital to link to EMS units)				
PSAP access to local media (may be thru law enforcement)				
Dedicated ring down line from PSAP to Local Exchange Carrier (LEC)(i.e.,telephone company) for network repair/problem resolution				

3. How reliable do you perceive the following to be? (circle VL, L, M, H, VH for very low, low, medium, high, or very high):

Connection	How reliable? (circle one)
Name/address identification (ALI) database	VL L M H VH
PSAP access to links which access ALI database	VL L M H VH
PSAP access to local law enforcement dispatch	VL L M H VH
PSAP access to EMS dispatch or EMS/Fire Combined	VL L M H VH
PSAP access to Fire Department	VL L M H VH
PSAP access to Poison Control Center	VL L M H VH
PSAP access to Trauma Center (or hospital to link to EMS units)	VL L M H VH
PSAP access to local media (may be thru law enforcement)	VL L M H VH
Dedicated ring down line from PSAP to Local Exchange Carrier (telephone company) for network repair/problem resolution	VL L M H VH

Exhibit E-3 (cont.)

4.Do you have name/address identification (ALI) database redundancy? ____Yes ____No.

5. If name/address identification (ALI) database is redundant, do you have the databases in geographically diverse locations? _____Yes ______No

6. Where does your name/address identification (ALI) database(s) reside? (check one or specify number if more than one)

   At the LEC ____________ At the PSAP ____________

7. Is there a designated alternate PSAP for your PSAP when rerouting is required?
   _______Yes ______No

8. If “yes” in 7, is the rerouting: (check one)

   _____automatic _____manual by LEC _____manual by PSAP personnel.

9. Are there other network reliability practices for 911 service that we should be evaluating? Please describe.

10. Do you have otherspecial arrangements in case of LEC (wireline) network failure? If yes, please describe. (examples may include alternate technologies, such as cellular, internal radio, microwave, etc.)

11. Please indicate number of times a loss of 911 service occurred in the last 12 months for each:

    ______LEC Network ______ALI Database

    ______PSAP CPE ______Other:specify:______________________________

12. With additional funds, what 911 enhancements would most benefit your reliability? Describe.

Exhibit E-3 (cont.)

13. Have you implemented a contingency plan for LEC (wireline) network failure? (check one)

______Yes ______No

14. Have you implemented a contingency plan for loss of the PSAP? (e.g. loss of CPE, PSAP evacuation)

______Yes ______No

Please provide the following information so that we may contact you for followup clarification if needed.

Name: ___________________________________ Title ______________________________

Phone #: ______________________

PSAP Identification (location) ____

Send completed questionnaire to: John Healy, Bellcore, 331 Newman Springs Road, Room 2X-227, Red Bank, NJ 07701-5699 or FAX to John Healy at (908) 758-4502.

Questions about this form should be directed to John: (908) 758-3065 or Debbie Guyton: (908) 758-5220.

Exhibit E-4

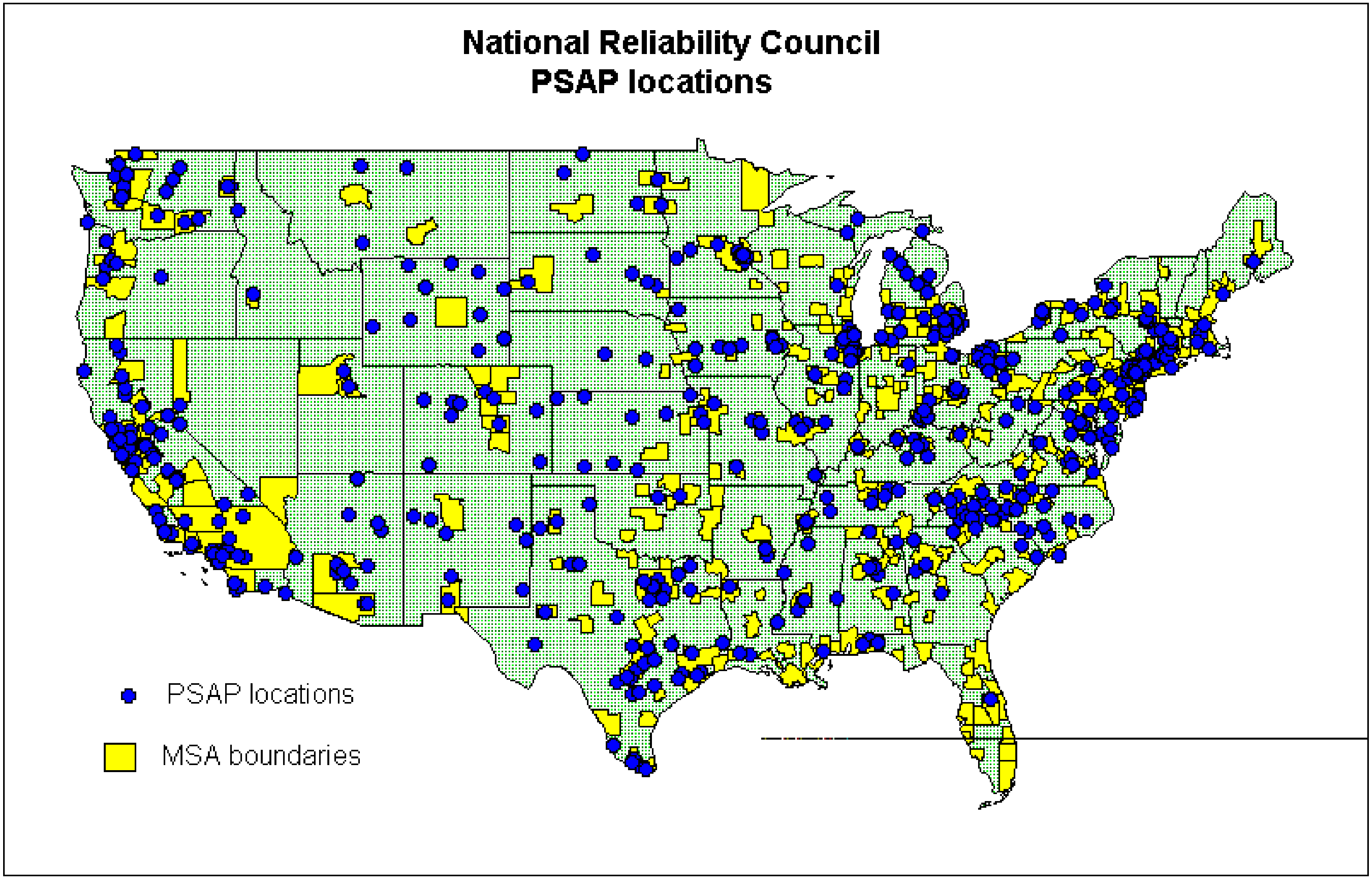
National Reliability Council
PSAP locations
PSAP locations
MSA boundaries

Exhibit E-5 Number of Respondents to the PSAP Questionnaire, by State

State	Metro	Non-Metro	Grand Total
Unknown*	0	1	1
Alaska	1	1	2
Alabama	7	1	8
Arkansas	1	1	2
Arizona	8	8	16
California	55	16	71
Colorado	3	7	10
Connecticut	12	1	13
Delaware	0	2	2
Florida	4	0	4
Georgia	3	2	5
Hawaii	0	3	3
Iowa	4	4	8
Idaho	1	1	2
Illinois	22	3	25
Indiana	2	2	4
Kansas	1	9	10
Kentucky	6	4	10
Louisiana	2	2	4
Massachusetts	5	1	6
Maryland	3	5	8
Maine	1	0	1
Michigan	26	14	40
Minnesota	7	2	9
Missouri	4	4	8
Mississippi	3	6	9
Montana	0	3	3
North Carolina	11	24	35
North Dakota	2	4	6
Nebraska	0	3	3
New Jersey	27	2	29
New Mexico	1	7	8
Nevada	1	1	2
New York	16	2	18
Ohio	27	4	31
Oklahoma	1	1	2
Oregon	4	2	6
Pennsylvania	5	2	7
Rhode Island	1	0	1

Exhibit E-5 Number of Respondents to the PSAP Questionnaire, by State (cont.)

State	Metro	Non-Metro	Grand Total
South Carolina	1	2	3
South Dakota	1	4	5
Tennessee	7	6	13
Texas	30	22	52
Utah	2	0	2
Virginia	5	6	11
Washington	11	6	17
Wisconsin	1	0	1
West Virginia	1	2	3
Wyoming	0	10	10
Grand Total	**336**	**213**	**549**

* indicates anonymous response-no state identified

Exhibit E-6 Questionnaire for Wireless/Satellite/CATV/CAP[1] Information

(To be filled in by each provider in the survey.)

Please provide the following information so that we may contact you for followup clarification if needed.

Name: ___________________________________ Title ________________________________

Company:___________________________________ Phone:______________________________

Address: ____

Type provider (check ones that apply)

___Cellular ____PCS ___ESMR[2] ___Mobile Satellite ___Satellite ____CATV ____CAP

1. Do you presently provide emergency services (e.g.911) directly to PSAP[3]?

   _____Yes _____No

2. Do you presently provide access to emergency services (e.g.911) via a LEC[4]?

   _____Yes _____No

3. If you provide access, what is your access code for emergency services (e.g.911)? (*123, *999, 911*, etc.)
   ____

4. Do you route to an emergency service other than 911/E911? (e.g. police, coast guard)

   _____Yes _____No

5. Are you working with a LEC to provide alternate transport emergency service (e.g. 911) (for backup)? _______Yes ________No

6. Do you plan to provide emergency services in the future? (check one)

   _______911 _______E911 _______Neither

7. Do you plan to provide access to emergency services via a LEC in the future? (check one)

   _______911 _______E911 _______Neither

---

[1] Competitive Access Provider (e.g. PBX)
[2] Enhanced Specialized Mobile Radio
[3] Public Safety Answering Point
[4] Local Exchange Carrier (i.e,. telephone company)

Exhibit E-6 (cont.)

8. Do you have plans to provide emergency services (e.g. 911 service) directly to a PSAP? Describe.

9. Do you have plans to pass customer name/number/location information to the PSAP (for E911 service)? Describe.

10. What are your recommendations for providing/accessing emergency services (e.g. 911 or E911)? Describe.

Send completed questionnaire to: John Healy, Bellcore, 331 Newman Springs Road, Room 2X-227, Red Bank, NJ 07701-5699 or FAX to John Healy at (908) 758-4502.

Questions about this form should be directed to John: (908) 758-3065 or Debbie Guyton: (908) 758-5220.

Exhibit E-7 PSAP Spending Priorities

The following types of comments were offered by PSAP respondents to the question of how they intend to invest in the future. They are provided here so that public safety providers may evaluate how others involved in the provision of emergency services intend to invest. Although investment priorities are varied, it should be noted that a large volume of responses were centered on wireless ALI and wireless selective routing needs, the leading concern of the public safety industry today.

No.	PSAP Investment Plan
1	Enhanced 9-1-1 (ANI/ALI).
2	Increased public awareness and education programs.
3	Extensive call taker training.
4	Additional answering personnel.
5	Centralized Dispatch.
6	Poison Center.
7	Translators for non-Spanish speaking people.
8	EMD Training.
9	PSAP management training.
10	Demand ALI search by telephone number.
11	ANI/ALI for private switch (PBX) end users.
12	Increased redundancy.
13	Improved backup systems.
14	Redundant ALI system.
15	Computer Aided Dispatch (CAD) system.
16	Diverse trunk routing.
17	Radio (microwave) backups to LEC landline networks.
18	Establishment of alternate PSAP.
19	Diverse routing via LEC SONET fiber ring.
20	Alternate routing.
21	Wireless instruments.
22	Portable backup power supply.
23	Mobile PSAP.
24	Backup logging (voice recording) device for 911 calls.
25	Update in-house telephone system.
26	Redundant CAD database.
27	A cell site on wheels (COW).
28	Redundancy of PSAP hardware.
29	Secondary PSAP arrangements.
30	Wireless phone with call forwarding.
31	Interface for wireless to existing console phones.
32	Wireless PSAP.
33	More frequent ALI updates.

Exhibit E-7 PSAP Spending Priorities (cont.)

No.	PSAP Investment Plan
34	Access to comment line in the ALI data base.
35	Demand search of the ALI system.
36	Display of apartment numbers and/or prominent place name (e.g., mobile home park) on the ALI system.
37	PSAP based ALI system as a backup.
38	Standalone ALI system.
39	Subscriber related comments (e.g., hazardous waster, etc.) in the ALI system.
40	Real-time ALI system updating.
41	ANI/ALI display on the Mobile Display Terminals (MDTs).
42	Subscriber related medical information on the ALI record.
43	User-friendly call history information management.
44	Electronic Mapping.
45	Addressing of rural locations.
46	Geographic Information System (GIS).
47	Mapping with display of caller location.
48	Cross street information.
49	Grid maps from all jurisdictions.
50	Geographic (GEO) based maps.
51	Open line ability.
52	Improved circuit monitoring.
53	Access to LEC wire center for 911 trunks.
54	Fiber optics.
55	Auto call back to the LEC when a LEC failure occurs.
56	Utilize the CCS network.
57	Network 911 without 9-1-1 tandem.
58	Selective routing of foreign exchange lines.
59	Decreased call setup time.
60	Faster emergency call tracing by the LEC.
61	Capture of ANI/ALI during call hangups.
62	Improved repair time.
63	Reverse 9-1-1 (demand search by address or name).
64	Upgrade logging recorder.
65	800 Mhz radio system for dispatch .
66	Management Information System (MIS) for call data analysis.
67	Direct connections to other PSAP’s.
68	Update PSAP technology.
69	Ring down lines to trauma centers, media, poison control, etc.
70	Conference call capability with 3 or more agencies.
71	TDD interface to CAD.

Exhibit E-7 PSAP Spending Priorities (cont.)

No.	PSAP Investment Plan
72	Auto Vehicle Location (AVL) technology.
73	Digital mapping.
74	Officer tracking system.
75	TDD automatic recognition.
76	TDD keyboards at each position.
77	56K to transmit CAD information over same links as ALI to response agencies.
78	Record management and tracking system.
79	Additional screens.
80	Audible “off-line” signal for 911 monitor.
81	Interface with digital phone system.
82	Conference link to conference multiple call centers.
83	Overflow arrangements with other PSAPs for all-trunk-busy conditions.
84	Caller ID for 7-digit emergency lines.
85	On-site testing of lines.
86	Dedicated ring down line for LEC repair.
87	Announcement package.
88	Larger ALI screens.
89	X/Y coordinates for wireless callers.
90	MSAG completion.

Exhibit E-8   Other PSAP Suggested Practices to Evaluate

The following types of comments were offered by PSAP respondents to the question of how to improve their reliability. They are provided here so that public safety providers may consider ways to improve the reliability of their networks or their ability to respond to emergencies.

No.	PSAP Comment
1	Extensive Training!
2	Evaluate funding levels. Too restrictive.
3	Practices for eliminating calls to 911 that are not of an emergency nature.
4	Train all call takers on pre-arrival instructions.
5	Place PSAPs at location under autonomous control without agency affiliation.
6	Establish LEC emergency training and procedures.
7	Train LEC engineers on emergency service needs.
8	Ensure LEC places high priority towards 9-1-1 and emergency services.
9	LECs should update subscriber addresses immediately when notified of correct location by the PSAP.
10	Establish 2-hour response for repair.
11	Improve notification of 9-1-1 service interruptions.
12	Provide ALI for private switch (PBX) users.
13	Establish route diversity for voice and ALI links.
14	Provide ALI system redundancy.
15	Provide redundancy for the switch.
16	Provide protected fiber optic ring to the PSAP.
17	Provide redundancy between the subscriber and the end office.
18	Provide redundancy/alternate routing between the end office and the 9-1-1 tandem switch.
19	Provide alternate technologies (e.g., radio) between the tandem switch and the PSAP.
20	Provide radio links (microwave).
21	Reduce risks of cable cuts via looped circuits.
22	Provide automatic alternate routing during disasters.
23	Use multiple long distance carriers for trunking.
24	Establish alternate routing to alternate PSAP.
25	Establish trunk monitoring and trouble detection.
26	Establish contingencies for power loss at the PSAP.
27	Utilize alternate technologies as backups to the landline networks (e.g., wireless, radio).
28	Provide quality control though management reports from the systems.
29	Establish user-friendly MSAG maintenance practices.
30	Provide PSAP direct search capabilities on the ALI system.
31	Improve MSAG and ESN reliability.

Exhibit E-8 Other PSAP Suggested Practices to Evaluate (cont.)

No.	PSAP Comment
32	Establish Geo files.
33	Complete rural addressing.
34	Establish faster ALI data update cycles.
35	Establish safer switch software update practices; exercising higher level of care.
36	Improve call setup time for PSAP-to-PSAP call transfers.
37	Reduce time needed to perform an emergency call trace.
38	Provide 24-hour/7-day surveillance of systems.
39	Improve test capabilities for resolving data line troubles.
40	Establish LEC practices for performing daily test calls to the PSAP.
41	Configure 9-1-1 networks top permit basic 9-1-1 during ANI/ALI controller failures.
42	Enable selective and fixed call transfer capabilities.
43	Upgrade from analog to digital technologies.
44	Establish self checks on alternate trunk routes to ensure reliability when needed.
45	Enable automatic ring back to callers if disconnected.
46	Enable identification of the end office of the originator for anonymous callers.
47	Establish Wide Area Network (WAN) configurations.
48	Improved teaming between LECs and private vendors in educating the PSAP on networks/interfaces.
49	Establish TDD and language lines.
50	Increase trunking for 9-1-1 access.
51	Improve accessibility to translator services. Frequently busy.
52	Establish dual CAD interfaces for redundancy. Provide direct link to Police Dispatchers.
53	Provide ANI and ALI on wireless phones (over 25% of call volume).
54	Provide routing of wireless callers to the appropriate PSAP.
55	Ensure LEC provides priority repair for emergency services.