

Network Reliability Performance Committee

Compendium of Technical Papers

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Network Reliability Performance Committee

Executive Overview

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EXECUTIVE OVERVIEW

Network Reliability Performance Committee Focus Team #1

Team Leader: Ray Albers, Bell Atlantic
Mentor: Frank Ianna, AT&T

1. Executive Summary

This document contains the reports of three teams that comprise the Network Reliability Performance Committee.

- ◆ The Performance Metrics Team sought to quantify the variations in frequency, duration, impact, and cause of outages both demographically and geographically for existing and emerging telecommunications industry segments.
- ◆ The Best Practice Team sought to quantify the implementation and effectiveness of best practices contained in the June 1993 report "Network Reliability: A Report to the Nation."
- ◆ The Outage Reporting and Customer Notification Team sought to determine whether and how customers of carriers should be informed of service outages, and to assess if other providers should report outages similar to the way that outages are reported by telecommunications providers.

2. Background

After a series of outages in the switched network in 1991, the reliability of the Telecommunications Infrastructure came under question by the Federal Communications Commission (FCC, also referred to as "the Commission") and other governmental bodies. In 1992, the Commission created the Network Reliability Council (NRC) as a federal advisory committee to provide recommendations to the Commission and the telecommunications industry. These recommendations, when implemented, would reduce the number and mitigate the effects of outages on the networks. The efforts of the council members and many others in the industry culminated in a 1,000-plus page report, "Network Reliability: A Report to the Nation." To ensure a continuation of the effort by the NRC, the Steering Committee (dubbed "NOREST") created, with the approval of the NRC, the Network Reliability Steering Committee (NRSC) under the auspices of the Alliance for Telecommunications Industry Solutions (ATIS).

The Commission felt it needed continuing advice regarding reliability improvement to the networks and, given the changes in the industry, needed "expert advice from the industry and its customers regarding any developments that may be threatening reliability."¹ The

¹ Letter to the Network Reliability Council from FCC Chairman Reed E. Hundt noting the continuation of the Network Reliability Steering Committee, April 29, 1994.

Commission also felt that some of the public may be disproportionately affected by service outages. Therefore, the NRC was extended to January 6, 1996, and its charter changed to be more forward looking. The following material is cited from the 1994 Charter.

The Committee's Objective and Scope of its Activity

The purpose of the Network Reliability Council is to provide recommendations both for the FCC and for the telecommunications industry that, when implemented, will assure optimal reliability of the public telecommunications networks. The committee will address:

1. Network reliability performance: The committee will evaluate on a quarterly basis the reliability of network services in the United States, on a local and regional basis, and review the industry recommendations contained in the June 1993 report "Network Reliability: A Report to the Nation."
2. New network reliability concerns arising out of increased interconnection: The committee will consider reliability concerns arising out of new network configurations resulting from the interconnection of new equipment and users to the nation's telecommunications network, and suggest ways to avoid compromising network reliability in an era of increasing interconnection.
3. New network reliability concerns arising out of changing network technologies: The committee will consider reliability concerns arising out of the provision of network services over an expanded variety of facilities and technologies, including coaxial cable, optical fiber, satellite, and wireless facilities, and, if appropriate, offer advice to ensure reliable provision of network services over non-traditional network facilities.
4. Essential telecommunications services during network outages: The committee will consider whether and to what extent essential services, including emergency 911 service, health, safety and other emergency communications services, and telecommuting services are unavailable or compromised during network outages, and suggest guidelines for ensuring that these essential services are kept operational to the maximum extent possible during outages.
5. The committee will also collect data on whether and to what extent network outages have disproportionate geographic or demographic impact.²

To accomplish its charter, the NRC created a new steering committee (NORESTII), which in turn set up five focus teams to implement the task as assigned by the FCC. The NORESTII asked that the NRSC take responsibility for task #1 and #5 of the charter.

3. Team Structure and Team Members

Since the NRSC was an established committee under the umbrella of ATIS, the team membership only needed to be augmented to bring in additional resources to complete its mission. An issue paper was developed by Ray Albers and Frank Ianna for approval of the NRC. (Appendix 1 of this section is the issue statement.)

Three subcommittees were established to address the work functions necessary to complete its mission. The Performance Metrics Team under the leadership of Eva Low,

² *Revised Charter for the Network Reliability Council/FCC, May 1994.*

Pacific Bell, took responsibility for the data analysis portion containing the demographic and geographic comparisons, and the local and regional analysis. Rick Harrison, ATIS Network Operations Forum (NOF) and Bellcore, volunteered to review the Best Practices for implementation and effectiveness. Additionally, Focus Team #1 was asked to respond to two questions as posed in FCC NPRM 91-273, the Second Report and Order, which asked:

- Should special facilities outage reporting be expanded to include satellite, cellular, and other wireless carriers?
- Whether and how should customers of carriers be informed of service outages?

These questions were assigned to Ray Albers as leader of the Outage Reporting and Notification Team. The NRSC organized these three committees under the Process and Procedures Team.

3.1 Team Members

NRSC Steering Committee

- P. J. Aduskevicz (Vice-Chair) - AT&T
- Raymond F. Albers (Chair) - Bell Atlantic
- Ann Andrews - BellSouth
- Raymond Bonelli - AT&T Network Services
- Royce Davis - GTE
- Jerry Depo - City Administrator, Town of Bloomsburg, Penn.
- Heather Gold - Association for Local Telecommunications Services
- Elizabeth Ham - Southwestern Bell Telephone Co.
- Steve Hewlett - NARUC
- Paul LaGattuta - NYNEX
- Larry Langrehr - Cable & Wireless
- Eva Low - Pacific Bell
- Norb Lucash - United States Telephone Association
- Tim Mack - Ameritech Services
- Clarence Meyer - Tele-Communications Association
- John Morgan - CWA
- Bill Pennington - DSC Communications
- Ron Pixler - MCI
- Louis J. Scerbo - Bellcore
- Silas Shannon - NCS
- Dave Stubbert - U S WEST
- Joseph F. Sullivan - Siemens Stromberg-Carlson
- Jerry Usry - Sprint
- Mike Verstagen - AT&T Wireless

3.2 Subcommittee Team Members

Performance Metrics Team

- Chuck Adams - AT&T Wireless
- P.J. Aduskevicz - AT&T
- Michael Angi - Colony Communications
- Wayne Chiles - Bell Atlantic
- Penny Christensen - U S WEST
- Harold Daugherty - NRSC
- Stan Edinger - AT&T
- John Healy - Bellcore
- Ari Jain - Bellcore
- Bill Klein - ATIS
- Eva Low (Chair) - Pacific Bell
- Norb Lucash - USTA
- Tim Mack - Ameritech
- Spilios Makris - Bellcore
- Ron Pixler - MCI

Best Practice Team

- Ron Binz - NASUCA
- Ray Bonelli - AT&T
- Royce Davis - GTE
- Ken Grace - Bellcore
- Elizabeth Ham - SBC
- Rick Harrison (Chair) - ATIS NOF and Bellcore
- Mel Kemp - MCI
- Tim Mack - Ameritech
- Archie McCain - BellSouth
- Jim Oeleis - U S WEST
- Jackie O'Rourke - Sprint
- Pete Shelus - AT&T
- Jerry Usry - Sprint

Outage Reporting and Notification Team

- Ray Albers (Chair) - Bell Atlantic
- Michael Angi - Colony Communications
- Daryl Brumley - IBM
- Harold Daugherty - Bell Atlantic
- Jerry Depo - City of Bloomsburg, PA
- Ken Grace - Bellcore
- Jim Lankford - SBC
- Archie McCain - BellSouth
- Art Prest - CTIA
- Thad Regulinski - University of Arizona
- Jerry Usry - Sprint

4. Findings and Recommendations

The "best practices" definition as used in network reliability focus area technical papers, and here as well, is: best practices are those countermeasures (but not the only countermeasures) which go furthest in eliminating the root cause(s) of outages. None of the practices 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 companies and products, respectively. It is understood that all countermeasures may not be applied universally.

4.1 Performance Metrics Team

The Performance Metrics Team, charged with evaluating reliability performance on a local and regional basis, and for demographic or geographic differences, found:

The wireline voice network is very robust, with little or no demographic or regional difference in network reliability within the LEC and IC industry segments. Outage frequency per switch is about the same for all population categories regardless of size, while the outage index consistently decreases from larger to smaller populated counties. The largest population category has longer outages than the other categories primarily because of facility outages. No important regional difference in network reliability was found. Hardware failures and software design failures are major factors in switch-related outages.

Quantitative analysis of cellular results does not indicate a major problem. There is no significant difference in outage frequency per switch across the population categories or the four regions (Northeast, Midwest, South and West). The average index per outage is significantly higher for the largest population category. The average outage duration is

higher for the West region, e.g., the median outage duration is 80 minutes versus 35 minutes for the other three regions. The findings suggest that there should be increased attention given to switch failure root cause analysis, and increased supplier focus on software reliability.

No analysis was performed on the CATV and satellite industry segments due to unavailable or incomplete data. Consequently, no conclusions can be drawn at this time regarding these two segments. Providers in these and other new industry segments seeking to provide telecommunications services are encouraged to review the recommendations of the Outage Reporting and Customer Notification Team.

4.2 Best Practice Team

The Best Practice Team, charged with the responsibility to review the industry recommendations ("Best Practices") contained in the June 1993 report "Network Reliability: A Report to the Nation," found a high awareness and implementation of Best Practices. Competing companies can share experiences with processes and procedures to the benefit of customers as a whole as well as new entrants to the industry. The implementation of Best Practices is valuable in preventing and mitigating outages, but does not guarantee that an outage will not occur. It is recommended that the industry continue to implement, internally track, and monitor implementation of NRC Best Practices, and use the tools developed by the Best Practice Team for implementation decision making, monitoring implementation, and outage reporting and analysis. Companies should continue to use industry forums such as the NOF and NRSC, and Standards organizations such as Committee T1 to introduce new Best Practices and propose changes to or obsolescence of existing Best Practices.

4.3 Outage Reporting and Customer Notification Team

The Outage Reporting and Customer Notification Team, charged with the responsibility to evaluate if other service providers (i.e., cable, cellular, & satellite) should report outages to the FCC, and to determine whether and how customers of carriers should be informed of service outages, developed the following recommendations.

4.3.1 Outage Reporting

The Outage Team concludes the following:

Individual service providers monitor their networks for trouble, take action when there is an outage, and have steps in place to improve the reliability of their networks. Two industry segments (Local Exchange Carriers and Interexchange Carriers) noted that forums exist that provide for open sharing of information on outages as well as recommending steps to prevent or mitigate the effects of outages. The Alliance for Telecommunications Industry Solutions' (ATIS) Network Reliability Steering Committee (NRSC) and the Network Operations Forum (NOF) are two examples

provided that directly address the causes of outages and through their process share information on the causes of outages and steps to prevent recurrence. Other industry segments are strongly encouraged to establish similar processes and forums or consider using the existing forums.

4.3.2 Customer Notification of Outages

The Outage Team concludes the following:

Existing mechanisms for outage notification (e.g., utilizing operators and media for 911/major events, etc.) are sufficient for notifying customers of service disruptions.

5. Note

Details for each subcommittee can be found in the individual reports contained in this paper:

Performance Metrics	B
Best Practices	C
Outage Reporting and Customer Notification	D

6. Acknowledgments

The NRPC wishes to acknowledge the efforts of all the industry participants who responded to data requests. The Committee also extends its deepest appreciation to the work orchestrated by subcommittee chairs Eva Low (Performance Metrics), Rick Harrison (Best Practices), and Ray Albers (Outage Reporting and Customer Notification)

The committee gratefully acknowledges the assistance of all the NRPC team members, with special thanks to members who wrote major portions of the report, including Harold Daugherty, Ken Grace, Rick Harrison, Ari Jain, Eva Low, Tim Mack, and Pete Shelus.

Special thanks go to our team leader, Ray Albers, and our mentor, Frank Ianna, for their guidance and encouragement; and to Bellcore for their outstanding data collection and analysis efforts.

7. Appendix

Network Reliability Council Issue Statement

Issue Title: Network Reliability Performance
- Local & Regional Basis
- Geographic and Demographic Impact

Team Leader:
Raymond Albers - Bell Atlantic

Steering Committee Champion:
Frank Ianna - AT&T

Problem Statement/Issues to be Addressed

The first Network Reliability Council recommended that the industry establish a group to monitor network reliability utilizing outage reports filed with the FCC as a high level indicator of network reliability. The Network Reliability Steering Committee (NRSC) sponsored by the Alliance for Telecommunications Industry Solutions (ATIS) was established in May 1993 and has to date issued weekly summaries of outage reports, five quarterly reports, and will release its first annual report in October 1994. The NRSC's analysis to date has been focused on a national level. The Network Reliability Council would like the NRSC to add to its mission by analyzing the effects of outages on a local and regional basis and the geographic and demographic impact of outages, and to review the industry's implementation of the recommendations contained in the June 1993 report "Network Reliability: A Report to the Nation."

Areas of Concern & Problem Quantification

1. Local and Regional Impact of Outages - What is the distribution of outages on a local and regional basis and is there variation in the availability of network services?
2. Based on the previous analysis, are specific outages more prone to occurring in certain areas (e.g., Fiber Cuts in warmer climates - South -- Power Outages in colder climates - North)?
3. Best Practices identified in the June 1993 report "Network Reliability: A Report to the Nation" - Are the Best Practices effective in avoiding or mitigating service outages, how are they being implemented by carriers and suppliers and are some more applicable to certain geographic areas? In addition, are the best practices applicable to other telecommunications networks (e.g., cable, wireless and satellite)?

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Description of Proposed Work

- 1) Local and Regional Impact of Outages - Develop (and if approved by NRC, implement) recommendations on Definition, Scope and Metrics. Examples of factors to be considered include:
 - a) Identify what data is available from which to determine the reliability of network services on a local and regional basis.
 - For example: Telco data (e.g., FCC Major Outage Reports, ARMIS)? Cellular data (e.g., FCC requires notification of outages of 90 or more continuous days). Satellite data (FCC's Laurel Satellite Monitoring Facility requests notification due to interference). Cable Data.
 - Data for other telecommunications network services.
 - What does the available data tell us about local and regional variation (if any) in the availability of network services.
 - b) What are appropriate definitions of "Regions."
 - c) Determine an appropriate baseline for service reliability measurement.
 - d) Analyze the effects of outages on a local and regional basis and determine where significant differences exist.
 - e) Evaluate the usefulness of present reporting mechanisms and available data for investigating the causes of service loss, avoidability of outages and effect of outages on particular services.
 - f) Assess how other service providers (e.g., cable, satellite, wireless, etc.) could monitor outage data similar to that reported by telcos.
 - g) Determine whether and how customers of carriers should be informed of service outages.
- 2) Geographic and Demographic Impact - Develop recommendations for appropriate geographic and demographic classifications, determine availability and sources of data and measures for characterizing outage impact. Examples of work include:
 - a) Evaluate the existing data and measures to determine if they are useful in analyzing geographic and demographic impact.
 - b) Determine if there are outage types more prone to certain geographic areas using currently available data (e.g., Major Outage Reports, ARMIS, NRC Technical Papers, etc.).
 - c) Investigate and enumerate ways to assess non-telco services (e.g., T1A1.2 type impact measure for cable, satellite, wireless, etc.).
 - d) Evaluate the need and develop plans for further and continuing data collection.
- 3) Best Practices - Recommend and implement relevant measures of the industry's implementation of Best Practices. Examples of possible factors to be considered include:
 - a) Determine if and to what extent industry is implementing applicable best practices (what do the quarterly and annual NRSC reports show).
 - b) Evaluate the effectiveness of applicable best practices for avoiding or mitigating service outages?

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- c) Determine the cost/value of applicable best practices.
- d) Determine if there are additional or new best practices which should be added to the current set being utilized in industry today.
- e) Evaluate if best practices have more applicability and effectiveness in certain geographical areas.

Existing Work Efforts

1. The NRSC solicited input from industry, for inclusion in its first Annual Report, to better understand how carriers and manufacturers went about evaluating, implementing and sharing the ideas and best practices contained in the FCC's "Network Reliability: A Report to the Nation." The NRSC requested input on the general approach to a) Follow-up on NRC recommendations, b) Specific recommendations which have been implemented and shown to be effective, c) Examples where implementation of Best Practices have resulted in improvement and d) Whether NRC recommendations resulted in closer cooperation and coordination in the resolution of outages. These voluntarily supplied data can form the basis for a preliminary report to the NRC.
2. Working group T1A1.2 has identified fifteen areas of future work related to identifying more appropriate methods and associated data to estimate the impact of network outages. These work items include the development of better outage index calculation methods for combined outages, consideration of weekend traffic patterns for modifying the time factors utilized, consideration of redefining services affected and service weights, and the development of new outage reporting criteria based on the network outage impact.
3. The Network Operations Forum (NOF) undertook a review and analysis of all NRC recommendations to identify potential NOF activities and issues. This resulted in the development of a matrix, mapping NOF activity and issues to the NRC recommendations, and the introduction of five new issues.
4. The NOF, through its Internetwork Interoperability Test Plan (IITP) Committee continues to be active in developing test scripts and test configurations, overseeing the performance of the tests and the reporting of test results to the industry. Test scripts have been developed and performed reflecting new and revised standards and requirements. Test Phases are scheduled through 1995.

Team Participants:

Network Reliability Steering Committee (Ray Albers - Bell Atlantic)

- Process and Procedures Team (PJ Aduskevicz - AT&T)
- Network Reliability Performance Committee:
 - > Performance Metric Team (Eva Low - Pacific Bell)
 - > Best Practices Team (Rick Harrison - NOF)
 - > Outage Reporting & Notification Team (Ray Albers - Bell Atlantic)
- Data Assembly and Analysis Team (Harold Daugherty - Bell Atlantic)

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