



NRSC Bulletin No. 2009-2 DS3 Outages MARCH 2009

Background

In order to address the Federal Communications Commission's (FCC's) concern over the increasing trend in the number of DS3 outage reports, the Network Reliability Steering Committee (NRSC) created the DS3 Outage Study Subteam in December of 2007¹.

Methodology of the DS3 Outage Study Subteam

Eight service providers and one vendor participated in this special study. As part of their efforts, the study participants examined the root and subcategory causes for DS3 outages, the outage duration, the magnitude of the outage, and the growth of DS3s in the network for the period of January 2005 to October 2007. Refinement of the outage data was accomplished by studying outage data by the identification and use of new cause subcategories. The DS3 Outage team findings were established and industry recommendations were identified as described below.

DS3 Outage Study Subteam Findings and Guidance

The intense analysis resulted in the following significant findings and recommendations:

- DS3 outages increased at a rate of 3.2% per month (January 2005-October 2007)
- NORS "Sympathy" reports (i.e. outages in an adjacent network) accounted for 17% of the outages
- The median DS3 outages lasted 8 hours and impacted 11 DS3s (50th percentile)
- Outages with 1, 2 or 3 DS3s grew at a higher rate than the overall rate
- DS3 outages (~80%) were caused by: cable damage, hardware failure, power failure, external environment or, were from unknown causes
- Within each of these areas, the actual cause was largely unknown (i.e. 70% of the cause subcategory was 'other')
- 10 new subcategories of direct cause were defined, studied and recommended for further review by the NRSC Outage Reporting Advisory Team. The recommended Subcategories are (note: the format below is Direct Cause: New Subcategory):
 - Cable Damage: **Fiber Failure**
 - Hardware Failure: **Card/Circuit Pack Failure**
 - Power: **Customer Premise**
 - Power: **Unidentified Power Surge**
 - Power: **Breaker Tripped/Blown Fuses**
 - Environmental External: **Animal Damage**
 - Unknown: **Outside Owned Network**
 - Unknown: **Third Party**
 - Unknown: **Cleared While Testing, Restored Before Cause Determined**
 - Unknown: **Other**
- "Fiber Failure" accounted for almost half of the outside Cable Damages (45%, increasing 6.2%/month)
- "Card/Circuit Pack Failures" was the biggest 'inside' contributor to Hardware Failure (69%, increasing 4.3%/month)

¹ A previous NRSC sub-team studied the non-service impacting DS3-simplex conditions – see [NRSC Bulletin 2006-1 DS3 Simplex](#)



Recommendation:

- That the FCC adds a "Sympathy Report" checkbox to NORS to allow the reporting party to indicate the failure occurred in another company's network, thereby allowing identification of redundant outage reports²
- Service Providers should review their "Cable Management" program
- Service Providers should review and implement the following new and modified "Cable Management" Best Practices, as applicable

NEW BEST PRACTICES – Cable Management

- **BP 7-P-0783 – Cable Management:** Network Operators and Service Providers should consider including spare fiber connectors and their locations in asset inventory systems
- **BP 7-P-0784 – Cable Management:** Network Operators and Service Providers should utilize appropriate fiber/cable management equipment or racking systems to provide cable strain relief and ensure that bend radius is maintained to avoid micro-bends (e.g., pinched fibers)

MODIFIED BEST PRACTICES - Cable Management

- **BP 7-7-0472 – Cable Management:** Network Operators and Equipment Suppliers should consider connector choices and color coding to prevent inappropriate combinations of cables
 - **BP 7-7-0423 – Cable Management:** Equipment Suppliers should provide cable management features and installation instructions for network elements that maintain cable bend radius, provide strain relief to prevent cable damage, ensure adequate cable connector spacing for maintenance activities, and provide clear access for cable rearrangement (i.e. moves/add/deletes) and FRU (Field Replaceable Unit) swaps
- Service Providers should review and implement Best Practices focused on the outage data collection process, including the proper cause-subcategory classification of the outage
 - Service Providers should conduct a review of their Vendor Management Program with a focus on card/circuit pack management
 - Service Providers should conduct a review of their sparing program with a focus on Best Practices (below)
 - For equipment carrying DS3 traffic, Service Providers should review and implement Best Practices related to redundancy/diversity and failover test (below)

FAILURE DATA COLLECTION & ANALYSIS BEST PRACTICES

- **BP 7-7-0422 – Failure Data Collection and Review:** Network Operators should collect failure-related data and perform cause analysis, impact and criticality analysis and failure trending. Network Operators and Equipment Suppliers should work together to jointly perform this analysis, and meet periodically with the specific agenda of sharing the failure and outage information to develop corrective measures

SPARING BEST PRACTICES

- **BP 7-7-0406 – Spares and Inventory:** Network Operators and Service Providers should, where appropriate, establish a process to ensure that spares inventory is kept current to at least a minimum acceptable release (e.g., hardware, firmware or software version)
- **BP 7-7-0504 – Spares and Inventory** Network Operators and Service Providers, in order to facilitate asset management and increase the likelihood of having usable spares in emergency restorations, should consider maintaining "hot spares" (circuit packs electronically plugged in and interfacing with any element management system, as opposed to being stored in a cabinet) for mission critical elements

² This recommendation was implemented by the FCC in January 2009



- **BP 7-7-5080 – Spares and Inventory:** Network Operators should identify and track critical network equipment, location of spares, and sources of spares to ensure the long term continuity and availability of communication service

REDUNDANCY/DIVERSITY BEST PRACTICES

- **BP 7-7-5075 – Network Diversity:** Network Operators and Service Providers should ensure that networks built with redundancy are also built with geographic separation where feasible (e.g., avoid placing mated pairs in the same location and redundant logical facilities in the same physical path)

FAILOVER TESTING BEST PRACTICES

- **BP 7-7-0421 – Fast Failover of Redundancies:** Equipment Suppliers should design network elements intended for critical hardware and software recovery mechanisms to minimize restoration times
- **BP 7-7-0461 – Fast Failover of Redundancies:** Equipment Suppliers should provide the capability to test failover routines of redundant network elements

The most up-to-date Network Reliability and Interoperability Council (NRIC) Best Practices can be found at <http://www.bell-labs.com/USA/NRICbestpractices/>.

Conclusion

As a result of the NRSC DS3 Outage Study Subteam’s findings and recommendations, the FCC has implemented the “Sympathy Report” checkbox in NORS. The NRSC determined that the two major contributors to DS3 Outages are fiber failures “outside the building” and hardware card/circuit pack failures “inside the building”. As a result, the industry has recommended that Best Practice reviews be conducted for each of these areas. Further, to reduce hardware failures, Service Providers are encouraged to enhanced their vendor management program (e.g., directly, TL 9000 SOTS, etc.). The industry believes these efforts will reduce the number of DS3 outages over time.