

Classification of Internet, Cloud and SDN/NFV Service Outages: A Real Challenge

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Some Observations - 1

- There is no official U.S. government database to report Cloud Service outages similar to the FCC's Network Outage Reporting System (NORS)* for outages reported by the telecom service providers
- “...Even though large scale Internet incidents have been reported in the media, and some papers include a brief list of several such failures, a taxonomy of key Internet failures showing the cause, duration, range, and effect does not exist...” **

* NORS: <http://transition.fcc.gov/pshs/services/cip/nors/nors.html>

** Source: Christian Doerr & Fernando A. Kuipers “All Quiet on the Internet Front?” IEEE Communications Magazine, October 2014, Vol. 52, No. 10

FCC: Federal Communications Commission

Some Observations - 2

- There is no standardized classification methodology (e.g., Root Cause, Direct Cause, Contributing Factors) for Cloud Service outages similar to the:
 - ATIS Standard* prepared by the Network Reliability Steering Committee (NRSC) promoting the use of a new classification system in the FCC's NORS
 - FCC's latest NORS User Manual**.
- A Google search with the key words “worst cloud outages” may give you part of the story*** but the root cause analysis mentioned in such analyses is subjective and based on an incomplete list of root cause categories

* Source: ATIS Standard Outage Classification, ATIS-0100012.2013, April 2013

** Source: FCC's Network Outage Reporting System (NORS) User Manual, Version 9, Nov. 22, 2013

*** Source:
<http://www.infoworld.com/article/2606921/cloud-computing/133109-The-worst-cloud-outages-of-2013-part-2.html>
<http://www.infoworld.com/article/2622201/cloud-computing/the-10-worst-cloud-outages--and-what-we-can-learn-from-them-.html>

Christian Doerr & Fernando A. Kuipers “All Quiet on the Internet Front?”
IEEE Communications Magazine, October 2014, Vol. 52, No. 10



Examples of Service/Network Outage Classifications

- FCC NORS
- ATIS NRSC
- TL 9000 (by the QuEST Forum)
- Ofcom (**O**ffice of **C**ommunications, Britain)
- ENISA (European Network and Information Security Agency)
- National Telecom Regulatory Authorities (TRAs)
- Literature/Publications
 - IEEE Papers
 - InfoWorld Articles
- Etc.

Example 1: Internet Service Outages (2007-2013)*

This Study** was based on:

■ Interviews with:

- Regional Internet Service Providers (ISPs)
- National Research & Educational Network Operators (NRENs)
- National Incumbent Operators
- Multi-national networks

■ Research

- Literary searches in academic and trade articles
- News websites
- Blogs, fora, and operator mailing lists about Internet incidents

* Period: June 2007 – December 2013

** Source: Christian Doerr & Fernando A. Kuipers “All Quiet on the Internet Front?” IEEE Communications Magazine, October 2014, Vol. 52, No. 10 (The authors are with Drecht University of Technology)

Example 1: Internet Service Outages (2007-2013) (Continued)

The Study:

- Investigated a broad scale of major (54) Internet failures and analyzed their root cause, frequency, duration, and societal impact
- Categorized/classified the Internet outages as following:
 1. Infrastructure failures
 - Network/cable, Energy, Hardware, Architecture, Software, and Disasters
 2. Border Gateway Control (BGC)
 - Hijacking, Hardware/Protocol
 3. Services
 - DDoS, DNS, SSL, and Miscellaneous (e.g., insider attacks, hacks, etc.)

DDoS: Distributed Denial of Service

DNS: Domain Name Service

SSL: Secure Socket Layer

Example 2: Cloud Service Outages in 2014 (till August 2014)*

- An article* at the InfoWorld listed the worst Cloud outages in 2014 (till August). Based on high-level information, the cause for the 12 listed outages may be attributed to:
 - 3 Denial of Service
 - 2 Improper Procedure
 - 2 “Undefined”
 - 1 Script Error
 - 1 Software Bug
 - 1 Fire
 - 1 “Routing Issue”

Is this ad-hoc root cause analysis, based on incomplete information, a satisfactory way to learn lessons from the cloud service outages?

* Source: J. R. Raphael, "*The worst cloud outages of 2014 (so far)*" InfoWorld, August 25, 2014

<http://www.infoworld.com/article/2606209/cloud-computing/162288-The-worst-cloud-outages-of-2014-so-far.html>

Proposed PAR Text for an IEEE Reliability Working Group

Issue Statement/Business Need:

Because the availability of communications services is vital for social-economic stability and public safety, the study of the reliability of the emerging software-defined and virtualized ecosystems (e.g., Cloud Computing, SDN/NFV, NGSON) can be very valuable. Since service providers are looking to use network functions virtualization to build dynamic, virtualized networks with application and content awareness they are changing the traditional equipment classification schemes by introducing virtual machines, hypervisors, etc. from many different suppliers. Various systems for classifying network equipment and direct/route causes of service outages currently exist for the communications industry. However, most do not account for advances in SDN/NFV-based network architectures, the new types of systems (e.g., Hypervisor) and failure modes (e.g., OpenFlow protocol). The **industry would benefit from an updated standard equipment categorization system and an updated standard classification scheme for direct/route causes used in outage analysis.**

Suggested Solution:

A future IEEE Reliability Working Group should **create a standard that offers a categorization of the:**

- (i) Equipment used in both legacy, converged and emerging technologies networks, and
- (ii) Direct/route outage causes that would be used in outage classification and analysis of the virtualized networks and associated services.

Proposed PAR Text for an IEEE Reliability Working Group

Issue Statement/Business Need:

Because there is no official U.S. government database to voluntarily report outages occurred in virtualized networks (i.e., similar to the FCC's Network Outage Reporting System – NORS - for outages reported by the telecom service providers), [capturing such outages in an IEEE database](#), would be:

- i. Of particular value to the industry for writing Best Practices based on lessons learned , and
- ii. Conducive to reliability analysis of virtualized networks from a root/direct cause analysis perspective

Suggested Solution:

A future IEEE Reliability Working Group should promulgate a voluntary reporting of outages occurred in virtualized networks to be captured in an IEEE database. Besides the industry, IEEE members from around the world may contribute outage information from:

- Literary searches in academic and trade articles
- News websites
- Blogs, fora, and operator mailing lists about outage incidents

