THE SERVICE RELIABILITY ECOSYSTEM

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THEME

ASSURED NETWORKS

SDN/NFV NETWORK AND NETWORK ELEMENT RELIABILITY STANDARDS CAN'T BE SENSIBLY CONSTRUCTED UNLESS YOU FIRST KNOW WHAT SERVICE RELIABILITY TARGETS YOU ARE TRYING TO MEET

OVERVIEW

- Service examples
- Customers want reliable services
- There is a language for talking about service reliability
- There is a theory and a set of engineering principles supporting reliable services
- Service reliability requirements are abstracted from any requirements for reliability of service delivery infrastructure (SDI) and its elements

OVERVIEW

- The reliability characteristics of the SDI determine the how reliable the service it supports will be
- The order in which you do things matters!
- Ecosystem diagram

TELECOM SERVICE EXAMPLES

- Voice telephony
  - POTS network
  - Connectionless networks
  - Mobile
- Internet access
  - TCP/IP WAN backbone
  - Local access varies
    - + Dial-up
    - + DSL
    - + Cable
    - + Optical

TELECOM SERVICE EXAMPLES

- Video teleconferencing
- Various entertainment services
  - Most mediated by the Internet
- Complex services
  - Point-of-sale credit approval
  - Mobile banking
  - Peer-to-peer services

CUSTOMERS WANT RELIABLE SERVICES

- *PC Magazine* reliability ratings of ISPs
  - Internet access service “outages”
  - Upload and download speeds
- Customer gripes about dropped calls in mobile services
- Verizon advertising

SERVICE RELIABILITY LANGUAGE

- Transactions
- Service failure classifications
  - Accessibility
  - Continuity/Fulfillment
  - Release
- Requirements for these are based on systems engineering understanding of customer needs and desires for satisfactory transactions in each service

SERVICE RELIABILITY
ENGINEERING PRINCIPLES

- Service failure modes can be catalogued
- Service failure mechanisms and failure causes are events or omissions in the SDI
- Congestion is always a factor in SDIs
  - Economically unreasonable to provision an SDI for every possible service demand
  - When SDI elements fail, a level of service demand that might have been supportable if everything were working properly will lead to increased congestion

SERVICE RELIABILITY
ENGINEERING PRINCIPLES

ASSURED NETWORKS

- So if you want to understand how reliable your service is,
  - Make a reliability model to relate the frequency and duration of service failures and outages to the frequency and duration of events or omissions in the SDI and/or
  - Collect and analyze accessibility, continuity/fulfillment, and release data
    - + DPM approach is followed by many service providers

SERVICE RELIABILITY
ENGINEERING PRINCIPLES

- And if you want to know what reliability requirements you should put on your SDI and its elements, “work the model backwards”

VOICE TELEPHONY
EXAMPLE

ASSURED NETWORKS

- "Carrier grade" service accessibility has always been claimed to be ≥ 0.99999 ("5 nines")
  - Does not account for delays
- "Carrier grade" service continuity objective was "no more than 250 DPM" (regardless of holding time)
- Service release failures were so rare that no one cared
- Some important questions still linger
  - Was the 2 hours downtime in 40 years switching system requirement really necessary?

VOICE TELEPHONY EXAMPLE

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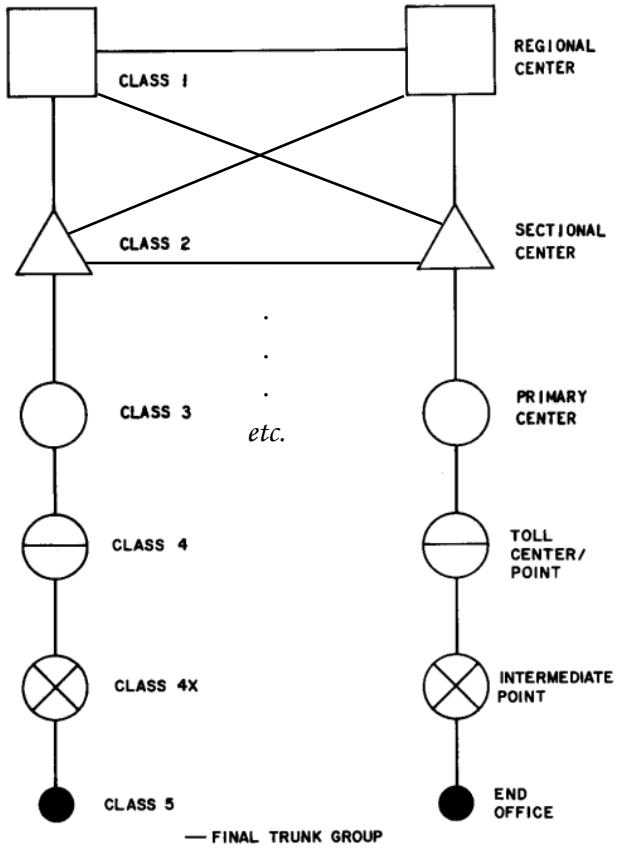
- Reliability model for the POTS network based on the 5-level hierarchy in the toll network
  - Using cut set – path set methods combined with renewal-reward models for network elements
  - Signaling on a separate SS7 network
    - + So signaling network failures need to be incorporated also
- AFAIK, it was never satisfactorily carried out to conclusion
  - Used “representative connections” approach
  - Generalized to histogram of connection types

VOICE TELEPHONY
LL TOLL HIERARCHY



VOICE TELEPHONY EXAMPLE

- Voice telephony can also be provided on a TCP/IP network
- Then it is called “VoIP”
- Service reliability requirements are the same!
  - Accessibility ≥ 0.99999
  - Continuity ≤ 250 DPM
  - Fulfillment?
  - Release negligible

VOICE TELEPHONY EXAMPLE

- What kind of TCP/IP network model do you need to extract these voice telephony service reliability descriptors?
- "Representative connections" makes no sense
- Simulation models hold promise
  - The gov't communication folks use these
- Need to determine router and transport systems reliability/capacity curves

INTERNET ACCESS
EXAMPLE

- The service is the simple ability to connect to the internet
- Service accessibility is the probability that you can bring up your home page when you want
  - Requirement?
- Service continuity is the probability that your browsing session will be interrupted by loss of internet connectivity
  - Requirement?

INTERNET ACCESS
EXAMPLE

- Service fulfillment is the probability that perceptual aspects (delays, video quality, etc.) of the experience are “satisfactory”
  - Requirements?
- Service release is the probability that the internet connection goes away when you dismiss it
  - Malware
  - Requirements?

INTERNET ACCESS
EXAMPLE

- Catalog of accessibility, continuity, and release failure modes
- Catalog of associated failure mechanisms in the TCP/IP network
- One of the reasons for inconclusive discussions about internet access service reliability is that not everyone agrees on the language
  - Telephone people
  - IT people
- Standardization can help here

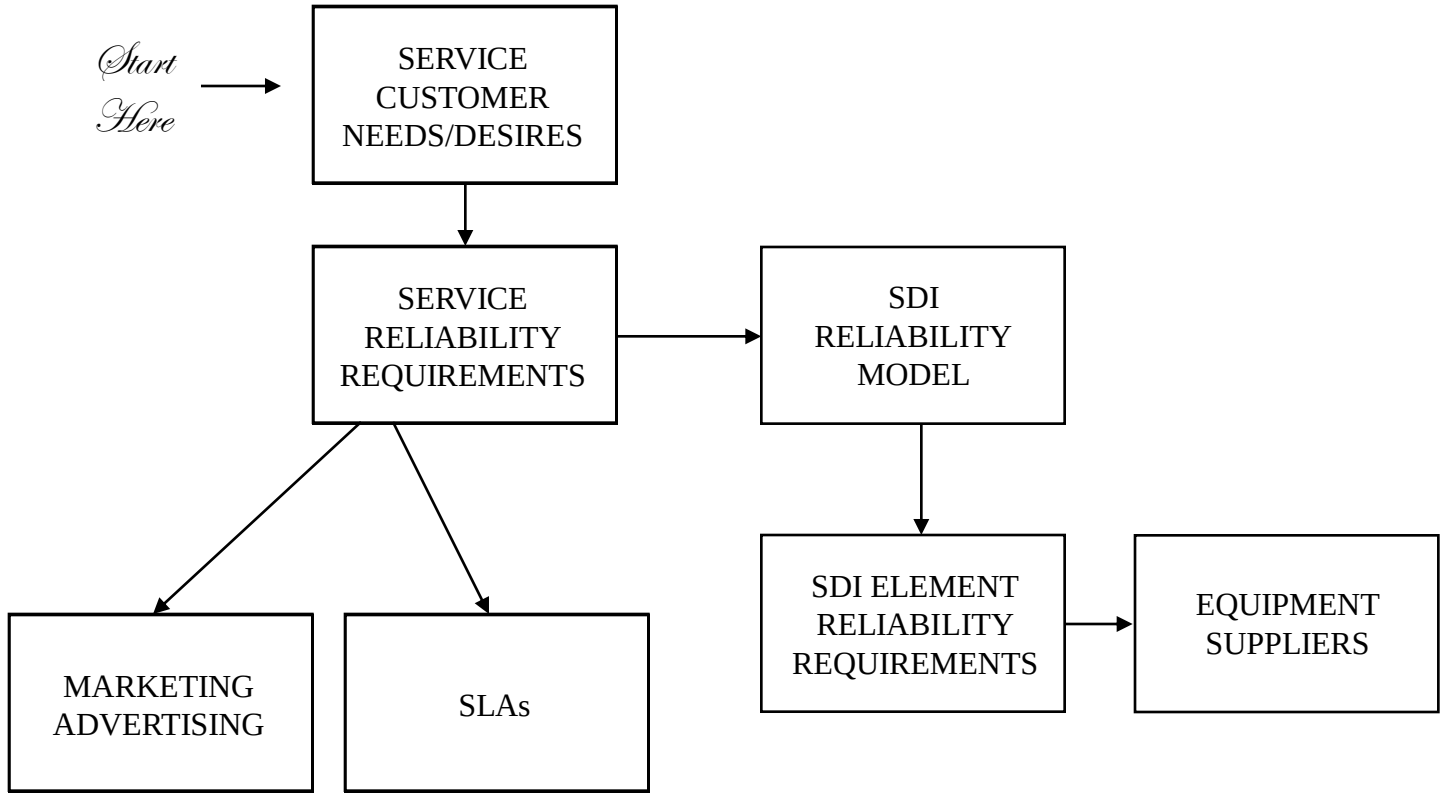
INTERNET ACCESS
EXAMPLE

- Reliability models for TCP/IP networks are considerably more complicated
- Analytical approaches via limit theorems for connectionless networks with unreliable elements
- Simulation approaches via OpNET, OmNET, etc.
- Whatever model is used, it needs to be focused on accessibility, continuity, and release at the service level

CONSEQUENCES OF INADEQUATE SERVICE RELIABILITY ENGINEERING

- Overprovisioning the SDI
  - Excess CAPEX
- Underprovisioning the SDI
  - More service failures than desirable
    - + Excess congestion

SERVICE RELIABILITY ECOSYSTEM DIAGRAM



CONCLUSIONS

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- Standardization benefits
  - Promote the idea of focusing on the service first
    - + Not every service provider need offer the same service reliability
    - + A service provider can offer different grades of service reliability
    - + Customers can make comparisons, analyze SLAs, etc.
  - Common language
  - Abstract the service reliability requirements from the SDI element reliability requirements
    - + Rational approach to SDI reliability requirements