Management and Operations of Networks, Services, and Systems

A Quality Network

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Challenges

- Large number of devices, and switching limitations
  - leading to capacity bottlenecks
- Specific requirements for users and applications
  - with service level commitments with users/clients
- Costs (!)
  - both capex and opex
- Traffic growth
  - and shrinkage (?)
- Network outages
- Users with different levels of access and accounts
- Attacks

Network design

- Do you have an idea of how the traffic flows in your network?
  - North-south, east-west, other?
- Different parts of the network may use different technologies and topologies
  - LAN, WAN, MAN ; access, distribution, core
  - STP, fat tree, etc
  - 1 – 10 – 25 – 40 – 100 GBps
- Segregation:
  - Workstations, Servers/Datacenter, public-facing (DMZ), admin, etc.
- Technologies:
  - Ethernet, VLAN, EtherChannel, MPLS, IP, OSPF, BGP
- Interconnection with other networks
  - ISProviders, BGP Peers, other networks of other departments

The “dev | fence | ops” trap, configuration

- Silos
  - Network planning and design
  - Network deployment
- Devops for networking allows a more iterative process of design, deploy, and getting feedback to update the network design
- Network function virtualization – helps
- Cost of hardware and hardware compatibility with future network expansions – hinders

Application quality requirements

- Capacity, bit/s – bandwidth intensive applications
  - Bursts – timescale – how long, how many bytes
  - Capacity vs. throughput vs. goodput
- Delay – real time, interactive applications
  - End-to-end delay (control)
  - Round-trip delay (teleconference)
  - Delay variation / jitter – visualization
- Reliability – mission critical applications
  - Error rates – bit, packet, etc
  - Mean time between failures - MTBF
  - Mean time to recover - MTTR
  - Availability = MTBF / (MTBF+MTTR) , Uptime(%) = 1-Availability
  - 99.999% uptime (5 nines) ⇔ 5.3 minutes down time in a year

QoS and traffic engineering, SLA

- Best effort networks
  - Lightly used – quality ok; Heavily used – quality degradation
- QoS
  - Queue management – choose packet, different queues
  - Round-robin, token bucket, RED, etc – algorithms
- tc linux
  - https://www.cyberciti.biz/faq/linux-traffic-shaping-using-tc-to-control-http-traffic/
  - Add 200ms delay, ad tocken bucket
    - tc qdisc add dev eth0 root netem delay 200ms
    - tc qdisc add dev eth0 root tbf rate 1mbit burst 10kb latency 70ms peakrate 2mbit minburst 1540

QoS and traffic engineering, SLA (2)

- ATM, intserv, diffserv+MPLS
- SLA – uptime%, minimum bitrate and delay, etc

- Why is QoS not a problem in circuit switching networks ?
  - What is admission control?

Faults

- Both hardware and software
- Root cause analysis – ‘root cause’ detector hard in complex networks
- Fault recovery – agile reconfiguration
- Fault detection – signal processing and machine learning

Security

- Enforcing security
  - Segregation
  - Access control
  - Firewall
  - IDS/IPS
  - …
- Security management
  - Vulnerability scanning
  - Intelligence gathering
  - Incident response
  - Forensics
  - …

Find out more about...

Network design

- How do you expose part of your network to the public without isolating that part from the rest of the network?
  - How does a DMZ work?
- What are typical network designs?
  - For a corporate network https://www.ciscopress.com/articles/article.asp?p=2448489
  - For a cloud provider
  - For an ISP https://au.int/sites/default/files/documents/31363-doc-session_8-1-_isp-network-design.pdf
- How does the Internet topology look like?
  - What is a PoP?
  - What is an Internet Exchange?
  - What is BGP?