S-38.3192 Verkkopalvelujen tuotanto
S-38.3192 Network Service Provisioning
Lecture 1: Network design principles

General Course Matter

• Schedule
  – Lectures thursdays 9-11 and 12-14
    • Not next week
  – Exercises fridays 12-14
    • Not this week
• Theme
  – Service provider business
    • From business goals to technical implementations
      – Focus on how big networks are designed and operated
General Course Matter

• Exercise
  – Design and verification (simulation) with ITGuru simulator
    • Provider network generalization
      – Topology
      – Technology
      – Routing
  
• Grading
  – Both exercise and exam needs to be passed
  – Course grade weighted combination of both grades
    • 40% exercise and 60% exam

Network Design Cycle

• Business Analysis
• Demand Analysis
• Technology Selection
• Topology Design
• Dimensioning
• Construction
• Commissioning
• Deployment
• Auditing
Business Analysis

• What is the network build for
• What is the revenue logic
• How secure is the revenue
• What is the estimated capex for the network
• How much opex is bound to the network (and services)
• How long is the depreciation time
• What will be life span for the network
• What will be the effect of investment to the ebit level
• What is the value of network investment to company value and/or strategy

Demand Analysis

• For who and for what is the network build
  – Who are served by the network
  – What are the services provided by the network
  – Where are the users located
  – How are users connected to the network
  – What are the connections to other networks
• What are the hypotheses for the usage
  – How much traffic is going to be delivered over the network
  – How many users are to be serviced
  – What is the required grade of service
  – What is the demanded resiliency
Technology Selection

- What are the most suitable technology to satisfy demand
  - From which layer are the services provided
    - IP, MPLS, L2, L1
  - Core technologies
    - Ethernet, ATM, SDH, RPR
  - Access technologies
    - Ethernet, DSL, CaTV, PLC

Topology Design

1. Define minimal design to connect all customers
2. Define the required connectivity level to achieve required resiliency level
3. Add required amount of loops to create defined connectivity level

- Physical topology
  - Transmission links
    - Resiliency build upon different physical connections
- Logical topology
  - Transport tunnels
    - Resiliency build upon different logical connections
Dimensioning

- Calculate offered load level for each link on the network
  - Take into account different routing behaviors
    - Distribution of traffic within the network depends on
      - Location of information sources and sinks
      - Routing topology during particular time
    - Error margins for these calculations are usually very large
      - There is no sophisticated queueing analysis methods for large networks and variable demands
      - Coarse approximations
- Select link capacity that fulfils the dimensioning goal
  - What will be acceptable overbooking ration within the network
    - Indirect influence to potential availability figure

Addressing

- There are several naming conventions that need to be decided
  - Identities: AD, SIP, ENUM
  - Canonical names: DNS, WINS
  - Network addressing: routing addresses, link addresses
  - Access point addresses: customer access networks
  - Customer addresses: end user addresses
  - Translations: NAT, ENUM
- Overall subnetting and naming needs to be well designed
Security

- How is the network secured from
  - Unintentional DoS attacks
  - Malicious traffic
  - False customer routing configurations
  - Unwanted traffic
  - Overload situations
- Access control lists / Firewall filters / Routing policies
- Traffic monitoring / Traffic policing / QoS control
- Syslog monitoring

Construction

- Acquire necessary transmission infrastructure
  - Dark / colored fibers
  - Framed transmission connections
- Measure each and every link separately
  - Joints and weldings of fibers
  - Electrical characteristics of copper cabling
  - Properties of transmission paths
- Take into account environmental issues
  - Power consumption
    - Backup energy source
  - Cooling
    - Heat dissipation (BTUs)
  - Electro/magnetical protection
  - Is network CII classified or just office network ;-)
Construction

- Configure each device protocol per protocol and test
  - There are several causalities between protocols
    - It is good to test them separately
- Make some form of version control
  - It is good to know what you have changed and when

Comissioning

- Is the final testing before ramping up the real services
  - Define the operational area where network services are usable
    - Resiliency and grade of service levels are met
  - Usually requires huge amount of iterations between
    - Protocol configurations and different service level parameters
- Pilot the network with real services
  - To see if they work the way you want
Deployment

- Ramp-up services and customers slowly to see how network operates
  - Also this phase is good to learn and teach operative personnel about tricks and corners of the new network
- Worst case scenario is the overnight roll-over from old network to a new
  - Uncontrolled load increase
  - Uncontrolled routing behavior
    - New customers are added frequently

Auditing

- Continuous auditing guarantees that traffic estimate and network are walking hand in hand
  - New traffic estimate is fed into network design process to produce new dimensioning (and based on the new capacity values also construction and commissioning)
- Auditing is also important for the customers satisfaction
  - Delivered service is within Service Level Agreement