Service Level Agreement - SLA

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Goals of this lecture

- After this lecture you should know
  - What a SLA is and what it contains?
  - What network services are and what other services an ISP might offer?
  - What options the ISP has for traffic differentiation?
  - How different types of services should be measured?

Service Level Agreement - definition

- **SLA is a contract that describes the service provided and the cost of the service.**
- Contract has two parties
  - Customer
    - End-user
      - Enterprise
      - Home user
    - Or a service provider as a client to another ISP
  - Service provider

Service Level Agreement - general

- The task of the SLA is to clearly define the roles, rights and oblications of contract parties at the service interface
- The contents of the contract depend upon the service type and structure offered to the customer
  - Network service (=ISP)
  - Application service (=ASP)
- The contract should contain only those services/applications over which the ASP/ISP has direct control

Service Level Agreement -details

- Contract defines
  - Service(s) offered
  - Cost of the service offered
  - Methods to control the servicel level
  - Procedures to follow in case of network malfunction
- The definition of service should contain all areas of the service and related performance and quality parameters
    - Network services
    - Application and other value-add services
    - Support services

Service Level Agreement - Examples

- Examples of measured performance and quality parameters:
  - Network capacity is x bps and its usability is y % over time z.
  - The webpage usability is a % measured over time b. The download capacity is c bps and the response time is less than d ms. The complete data is backed up every f days/weeks/months.
  - Customer VPN is offered a capacity of m bps with maximum end-to-end delay of n ms

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Service Level Agreement - usability

- Service availability (or usability) indicates the time that the service is available (or usable).
- Common terms and definitions with availability/usability are

Käytettävyys	Epäkunnossa Per vuosi	Per viikko
90%	36,5 pv	16,85 h
95%	18,25 pv	8,42 h
98%	7,3 pv	3,37 h
99%	3,65 pv	1,68 h
99,5%	1,83 pv	50,54 min
99,8%	17,52 h	20,22 min
99,9%	8,76 h	10,11 min
99,95%	4,38 h	5,05 min
99,99%	52,56 min	1,01 min
99,999%	5,26 min	6,06 s

  - *MTBF - Mean Time Between Failures*
  - *MTBI - Mean Time Between Interuptions*
  - *MTTR - Mean Time To Recover*
  - *These define the availability slightly better than just plain percentage values.*
    - Not a vague definition "over time t…"
    - Not just one long break in the service

Service Level Agreement – costs of ISP

- **The level of SLA parameters defines the cost of offering the service (for the ISP)**
  - **Key objective: Aim for high utilization!**
    - **Exact knowledge of traffic profile and behavior**
    - **Or accept the fluctuation of the service level (because of statistical multiplexing)**
  - **Low level of utilization increases the unit cost (significantly)**

- **Example:** 99.99% usability over one week period means a service that is unusable for less than a minute (within that same week)
  - This does not make it possible even to maintain the equipment without redundancy
    - Redundant equipment (and access to the network)
  - 99% usability enables the maintenance without contract violation

ISP ideal

- The aim of the ISP is
  - **To increase incoming cash flow**
    - Higher unit price to services with higher priority
    - Utilize network infrastructure to the fullest
      - Statistical multiplexing
  - **Ensure market position**

Optimal network state
- offered load is high enough to cause increase in the delay, yet the utilization (offered capacity) is still high
- Only fraction of the traffic is offered any guarantees on the service level

Delay

Capacity offered

Offered traffic

Network services – private access

- **Access services**
  - Private access service is based on the control of the customer's access line (and control of the attached closed service network)
    - Fixed lines
      » xDSL or DOCSIS-technologies for home users
      » Any symmetrical technology in enterprise usage
      – Dial-in access to ISDN/PSTN
    - ISPs may offer differentiated access services based on customer's access bit rate.
      – xDSL, PDH and ATM –based access lines make it easy to change access bit rate

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Network services – public access

- **Access service**
  - Public access service is based on customer/transit contracts made by the ISP with other ISPs
    - If a customer uses this service he/she/it is offered
      – Global IP-addresses (no NAT, no private IP-addresses)
      – Access point from where traffic is routed onwards.
    - ISP controls the performance and service level of the access.

Network services - transit

- **Transit service**
  - **Enable the networking of ISPs**
  - **Small ISPs are customers to larger ISPs**
    - **Large ISPs forward the traffic as their customer traffic**
  - **Equal size ISPs work together as partners**
    - **Each are other's customers**
    - **Mutual contracts contain mainly restrictions regarding the forwarded traffic.**

Value add services

- All supportive services that support network traffic are referred to as *value add services*
  - Virtual network services (VPN)
  - Operating application services (email, web hosting, …)
  - Managing name services (and their integrity) (DNS)
  - Controlling and managing customer equipment (DHCP on the very basic level)

Separate services

- **L1-leased line**
  - **Blackfiber**, customer has full access to the physical layer (the fiber)
    - Customer operates the fiber and everything on it
  - **Colorfiber**, customer gets only the logical access
    - Physical operating based on line technology and on ISP responsibility
    - Logical operation on customer responsibility
- **L2-leased line**
  - Parts of operator capacity on layer 2
  - Capacity may be changed as needed (and possible)

Separate services

- **L3-leased line**
  - Customer is offered IP tunnels between access points.
    - Service is based on
      - IP-tunneling
        » Secure (IPSec) or unsecure (PPTP, GRE)
        » Service controlled with IP management
      - L2+ tunneling (MPLS)
        » Capacity and routing separate from other network

Differentiating traffic - QoS

- **Traditional concept** of QoS is based on fulfilling <u>commonly accepted</u> parameters
  - For instance PSTN call blocking should be less than 2%
  - There is no differentiation of traffic based on QoS
- **IP-networks and related business** is heavily competed
  - ISPs aim to offer network level QoS (and thus stand out from other ISPs)
    - Performance values are attached to network level services These values must be able to be measured
    - Other services of the ISP are evaluated with quantitative measures
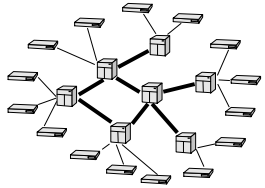   - Quality certificates etc.

Bringing life to QoS

- ISPs have limited methods and power to offer quality differentiated services
  - More hardware, faster hardware,…
    - Traffic shaping
    - Usage based billing
  - Differentiated Services (DiffServ)
  - Multiprotocol Label Switching (MPLS)

More hardware…

- **Overdimension the network (with proper gusto)**
  - All customer traffic can be carried in any situation
  - True utilization will notably low
    - On average there is a lot of unused capacity (waiting that the "any situation" will happen).
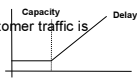
Faster hardware…

- Differentiation is achieved by
  - Actively shaping traffic at user access point
    - Customer is offered a certain capacity and customer traffic is shaped/buffered to this capacity
      - More traffic, more delay

  - Billing users according to offered traffic
    - Customer controls traffic based on what she/he is willing to pay.
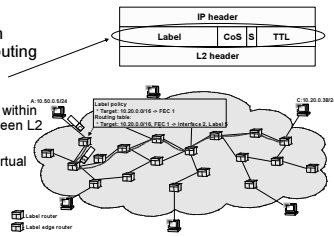   - Slow reaction time (depending on the billing system)

Multiprotocol Label Switching

- MPLS builds virtual connections based on information from IP routing (on top of any L2 technology)
  - Connection identifiers within the L2-header or between L2 and L3 headers
  - Enables end-to-end virtual networks

Differentiated Services

- DiffServ is a method to build logically separate IP-networks into one physical IP-network
  - Logical network is identified with IP-header DSCP / ToS - field
  - Each logical network is treated individually and separate from others
   - Although, the resources used by one logical network have an effect on the other logical networks

What do you sell with SLAs?

- **Managed services**
  - Including
    - (Differentiate) network service
    - Value add services
      - Email
      - WWW
      - Security services
  - Built upon
    - The know how and equipment of the ISP
  - Covering
    - ISPs own network
    - Outside of ISPs network only a limited set of services are offered
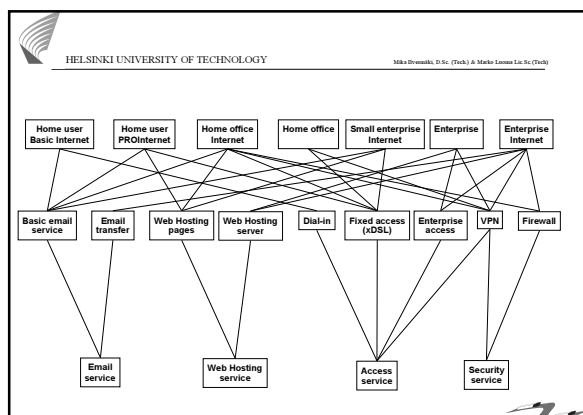
Measuring service quality

- **When defining quality measure, remember to measure only that what is quantitative**
  - Measured value should be defined in the SLA so that they can be measured by the operator and customer alike.
  - Do not attach any qualitative or otherwise unexact values (no "feelings of good network service level")
  - Vague definitions lead to controversy that most probably lead to a sensation of unsatisfying (total) quality of service.
    - "Collective effect of service performances which determine the degree of satisfaction of a user of the service" [ITU-T E.800]

Measuring service level

- **Quantitive service level (measure)**
  - Describes the service performance on different (protocol) levels
  - Defined unambiguously
    - Service logic illustrated as flow chart
    - Numerical values of performance attached
      - Can be measured

- **Qualitative service level (based customer experience)**
  - Illustrates the service level/ service response experienced by the customer
  - The response depends on factors that can not be measured
  - Ambiguous definition
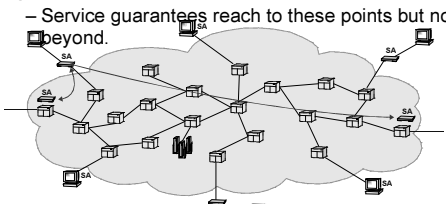   - Can not be measured

Measuring service level

- It is in the best interest of the customer to control that the contract (=SLA) is fulfilled.
  - Measure the parameters mentioned in the SLA with the best applicable practise (that could also be documented in the SLA)
    - Service is measured where service is used
      - Customer premises, workstations, access points
      - From the transit point towards the ISP value add service point.

Measuring service level
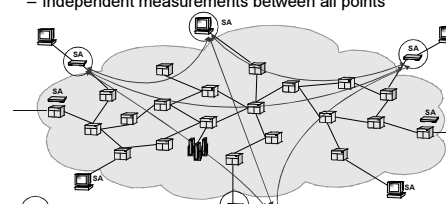
- Typically measured between the transit points
  - Service guarantees reach to these points but not beyond.

Measuring VPN-service

- At the ends of VPN-tunnels or measurement points within the customer network
  - Independent measurements between all points

IPSec VPN päätepiste

Application service measurements

- The ASO has measurement points within its network.
  - The usability is checked from these points
    - Placed at least to transit points