

SLA - Service Level Agreement

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Tietotieteiden ja tietoväkkötekniikan laitos (TKL)

Contents

- > Service Level Agreement
- > Measuring Quality of Service
 - > Measurement tools
- > SLA-monitoring and reporting

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Service Level Agreement

- > SLA is a formal contract that describes the service provided and the cost of the service
- > Contract has two parties:
 - > Customer
 - » End-user
 - » Enterprise
 - » Home user
 - » A service provider as a client to another ISP
 - > Service Provider

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ISP Hierarchy

More on this topic in the Peering lecture

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Service Level Agreement

- > **The function of the SLA** is to clearly define the roles, rights and obligations of contract parties at the service interface
- > **The contents of the contract** depend on the service type and structure offered to the Customer:
 - > Network service (Internet Service Provider, ISP)
 - » The structure and control of the service is ISP responsibility
 - » The structure and control of the service is Customers responsibility
 - > Application service (Application Service Provider, ASP)
 - » Web, email etc.
 - > The contract should contain only those services/applications over which the ASP/ISP has direct control

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Service Level Agreement

- > SLA as a contract:
 - > A long term agreement between the Customer and the Service Provider
 - > Is signed when the customership begins
 - > The SLA
 - » Has value in marketing
 - » Enables comparison between incoherent and hard-to-comprehend products
 - » Makes it easier to present the properties of such products
 - » Has technical meaning
 - » Unambiguously describes the service offered to the Customer
 - » Is a juridical agreement
 - » Protects the Service Provider from possible legal acts in case the customer is not satisfied with the service

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Service Level Agreement

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

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Network services – private access

- > **Private access**
 - › Private access service is based on the control of the Customer's access line (and control of the attached closed service network)
 - › Connecting the Customer's sites with a closed network (= Virtual Private Network)
 - › Access lines can be
 - › Fixed line connections
 - › xDSL, DOCSIS or Ethernet-technologies for home users
 - › Any symmetrical technology for enterprise users
 - › Wireless connections
 - › 3G, @450, satellites
 - › ISPs may offer differentiated access services based on the Customer's access line
 - › Capacity
 - › Delay
 - › Packet loss
 - › Guaranteeing of these quality/performance parameters, independent of time or load level, is called Quality of Service

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Network services – public access

- > **Public access**
 - › 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.

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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.

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Value-added services

- > All supportive services that support network traffic are referred to as *value add(ed) services*
 - › Virtual network services (L2, L2+, L3 VPN)
 - › Operating application services (email, web hosting...)
 - › Security services (Firewall, IDS etc.)
 - › Managing name services and their integrity
 - › Controlling and managing customer's configuration and/or equipment (Managed LAN service)

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Performance and quality metrics: 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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Usability

- > The service availability (or usability) indicates the time that the services is available (or usable)
- > Common terms and definitions with availability/usability are:
 - › MTBF - Mean Time Between Failures
 - › MTBI - Mean Time Between Interruptions
 - › MTTR - Mean Time To Restoration
- > These terms 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

| Unavailable | | | |
|-------------|----------|----------|---|
| Usability | Per year | Per week | |
| 90 | 36.5 | 19.85 | h |
| 95 | 18.25 | 8.42 | h |
| 98 | 7.3 | 3.37 | h |
| 99 | 3.65 | 1.69 | h |
| 99.5 | 1.825 | 0.845 | h |
| 99.8 | 0.73 | 0.37 | h |
| 99.9 | 0.365 | 0.1825 | h |
| 99.95 | 0.1825 | 0.09125 | h |
| 99.99 | 0.073 | 0.0365 | h |
| 99.995 | 0.0365 | 0.01825 | h |
| 99.999 | 0.01825 | 0.009125 | h |

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MTBF - ITU-T definition

- > Item
 - › "Any part, device, subsystem, functional unit, equipment or system that can be individually considered."
- > Failure
 - › "The termination of the ability of an item to perform a required function."
- > Time Between Failures
 - › "The time duration between two successive failures of a repaired item."
- > Mean Time Between Failures
 - › "The expectation of the time between failures."

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MTBI - ITU-T definition

- > Interruption
 - › "Temporary inability of a service to be provided persisting for more than a given time duration, characterized by a change beyond given limits in at least one parameter essential for the service."
- > Time between interruptions
 - › "The time duration between the end of one interruption and the beginning of the next."
- > Mean Time Between Interruptions
 - › "The expectation of the time between interruptions."

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MTTR - ITU-T definition

- > Mean Time To Restoration (Recovery, Repair)
- > Time To Restoration
 - › "The time interval during which an item is in a down state due to a failure."
- > MTTR
 - › "The expectation of the time to restoration."

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Service Level Agreement

- > The level of SLA parameters defines the cost of offering the service (for the ISP)
 - › The higher the bandwidth or delay demands, the more expensive the service is
 - › This applies also to availability/usability

Example:

- > 99.99% usability over one week period means a service that is unusable for less than a minute (during that same week).
 - › Makes it impossible to maintain equipment without redundancy
- > Redundant equipment and access to network
 - › Raises the costs for the ISP
- > 99 % usability enables the maintenance of network equipment without violating the contract (1,5 hours per week)

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Service Level Agreement

- > 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 practice (that should also be documented in the SLA)
 - » Service is measured where that service is used
 - › Customer premises, workstations, access points
 - › From the ISP provided measurement device located in the customer premises
 - › From the transit point of the ISP towards the ISP's value added service point

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Measuring service quality

> When defining quality measure, always separate fact from fiction: measure only that what is quantitative

- > The measured value should be defined in the SLA so that it can be measured by both the SP and the Customer
- > Do not attach any qualitative or otherwise inexact values that are based on human interpretation or experience
 - » The human effect is dependent of the person and his/her feelings
 - » The end-user can't be controlled by the Service Provider
- > Vague definitions lead to controversy that most probably leads 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]

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Measuring service level

> Quantitative service level

- > Describes the service performance on different protocol levels
- > Can be defined unambiguously
 - » Service logic illustrated as a flow chart
 - » Numerical values of performance can be attached
 - » Can be measured

> Qualitative service level (based on customer experience)

- > Illustrates the service level / service response experienced by the end-user (Customer)
- > The response depends on factors that cannot be measured
- > Ambiguous definition
 - » Can not be measured

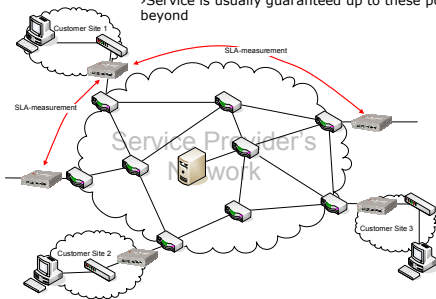
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Verifying the SLA of a network service

- > Typically measured between the ISP's transit points
- > Service is usually guaranteed up to these points but not beyond



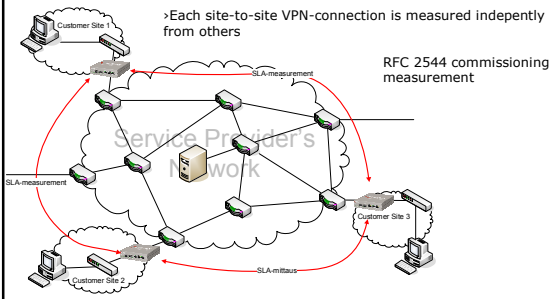
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Verifying the SLA of a VPN service

- > From the ends of the VPN-tunnels or measurement points within the customer network
- > Each site-to-site VPN-connection is measured independently from others



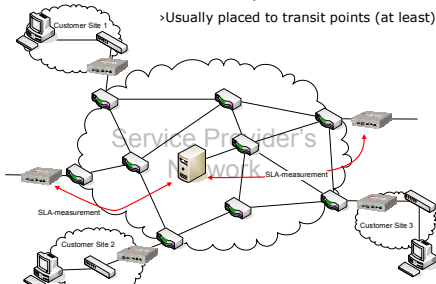
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Verifying the SLA of an application service

- > The ASP has measurement points within its network where usability is measured from
- > Usually placed to transit points (at least)



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SLA-measurements

> Measured performance/quality metrics include

- > Delay, one-way or two-way
- > Delay variation (jitter)
- > Packet loss
- > Reachability
- > Availability
- > Response times (e.g. Web-server first page Download time, TCP-connection time)
- > Throughput, available bandwidth

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RFC 2544

- > Originally defined to offer a standardized set of tests for measuring network device performance (latency, frame loss etc.)
 - > Test framework can be also used to measure a network service's SLA conformance
 - » Commissioning measurement for VPNs or Ethernet services
 - > RFC-2544 outlines specific tests to validate throughput, latency, frame loss, and back-to-back (burst) performance
 - > Full line-rate traffic generation with small and big frames

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Measurement methods

- > End-to-end measurement
 - » Probes are sent from point A to point B
 - » E.g. UDP or ICMP packets
 - » Packets are timestamped on departure and arrival
 - » Packets are given sequence numbers
 - » Network's response is measured by observing the timestamps (delay, jitter) and sequence numbers (packet loss) on the packets
- > Sometimes end-to-end not possible
 - » Measured path may cross several independent domains with conflicting policies, measurement tools, methods etc.
 - » Session Border Controllers break the end-to-end connection of a VoIP call
 - » RTCP statistics are not end-to-end but from the caller to the SBC

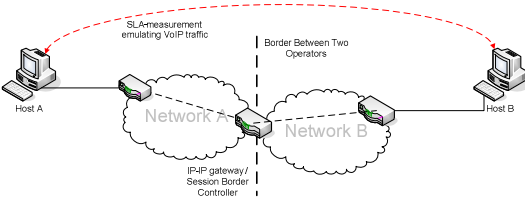
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Loss of end-to-end connection

- > SLA-measurement using an emulated VoIP call: MOS, RTT, OWD, Ploss statistics
- > SBC performs transcoding (e.g. From G.711 to G.729)
- > The call initiated by Host A is terminated in the gateway and then in turn initiated by the gateway and terminated by the Host B
- > The gateway breaks the connection between the caller and the called



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Spatial composition

- > Based on the idea that measurements of the sub-paths can be combined so that the result estimates the properties of the complete path
- > Can be used to get an estimate of the properties of a inter-domain path without a separate end-to-end measurement
 - » Each domain measures its edge-to-edge sub-path

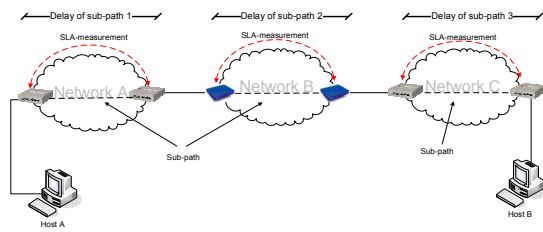
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Spatial composition example

- > Combining sub-path measurements to get an estimate of the end-to-end one-way delay of a network path



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Measurement considerations

- > Bandwidth usage of SLA-measurements
 - » Active measurements cause extra traffic and thus disturb the normal traffic in the measured network
 - » Intrusiveness
 - » Probing traffic should only use a few percent of the measured network path's available bandwidth
 - » RFC 2544 Commissioning measurement uses up all available BW
 - » Reporting measurement data to DB takes up BW as well
- > Measurement accuracy
 - » Typically only expensive devices reach <1ms accuracy (delay measurement)
 - » Operators have accurate measurement devices in their core networks
- > The service should be measured on the layer it is offered
 - » E.g. a L2-service cannot be measured with TCP-throughput test...

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SLA-measurement tools

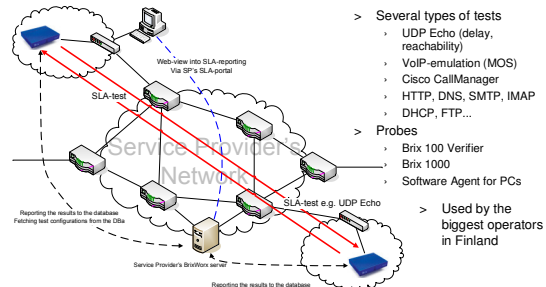
- > Tools are based on operating system dependent measurement software or separate measurement devices
 - Measurement Agents (software)
 - Measurement Probes (hardware)
- > A measurement device located on the Customer premises
 - Run the tests described in the SLA
 - Transfers the test results to the Service Provider's centralized database
- > SP's database reports the results to the Customer according to the SLA

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Example: Brix Measurement platform



- > Several types of tests
 - UDP Echo (delay, reachability)
 - VoIP-emulation (MOS)
 - Cisco CallManager
 - HTTP, DNS, SMTP, IMAP
 - DHCP, FTP...
- > Probes
 - Brix 100 Verifier
 - Brix 1000
 - Software Agent for PCs
- > Used by the biggest operators in Finland

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Measurement probes

Accedian EtherNID

- > Can be installed in-line or one-armed
- > Demarcation device
- > Layer 2 and 3 tests
- > In-service RFC 2544 test
- > Splitter functionality
- > 1 Gbps interfaces with changeable SFPs



Brix 100M Verifier

- > One-armed installation
- > 100 Mbps interface
- > Layer 3-7 tests

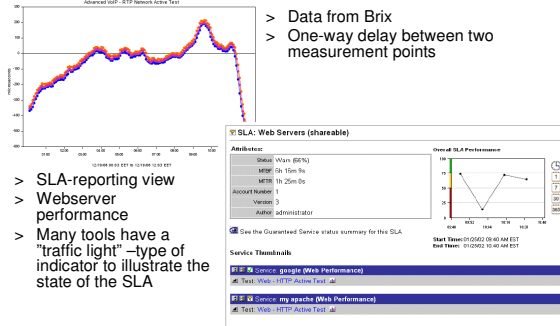
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SLA-reporting

- > Data from Brix
- > One-way delay between two measurement points



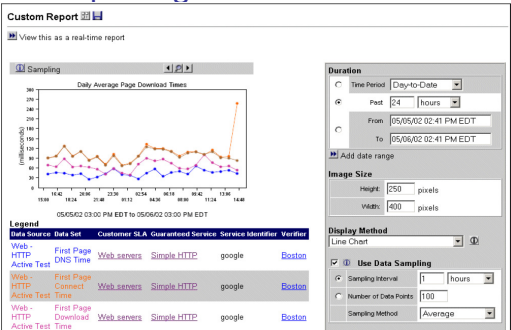
- > SLA-reporting view
- > Webservers performance
- > Many tools have a "traffic light" -type of indicator to illustrate the state of the SLA

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SLA-reporting



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Summary

- > SLA is a contract, not a set of rules
 - It should not be seen as a threat
- > The function of SLA is to create a structured view of what the Customer needs and what the SP has to offer and the relation between these two
- > Works as a referee in disputes
- > Thus, it must be clearly measurable and observable by both the Customer and the SP
- > SLA measurement methods must be agreed upon so that they can be used to decide if the contract has been fulfilled or not

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