End-to-end IP Service Quality and Mobility

- Lecture #1 -

Special Course in Networking Technology

S-38.215

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Agenda

- Bureaucracy
  - Course material
  - Planned contents & schedule
- Goals of the course
- Rôle of IP
- Service quality
- All-IP network
- Service concepts
- Rôles of operators
- Assumptions about end-to-end functionalities.

Bureaucracy

- 2 study credits.
- Can be used as part of post-graduate studies.
- Prerequisite knowledge: S-38.180 Quality of Service or equivalent knowledge.
- Twelve 90-minute lectures at 10 o'clock on Mondays in lecture room H402.
  - Lecture schedule will be shown in the course home page.
- Course material and exercises will be distributed at lectures.
- Grading based on examination.
- There will be a final examination + another examination later.
  - Dates will be announced on course home page.

Contact information

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  - Nokia switch 07 180 8000.
- HUT contact: Johanna Koivisto
  - HUT switch 09 4511.

Goals of the course

- Understanding of issues which need to be taken into account in providing advanced services in systems supporting IP mobility.
  - GSM evolution systems (GPRS, EDGE, WCDMA).
  - IP-based access networks.
- Systems approach.
  - End-to-end service quality target.
  - System components and protocols needed for this.
- Service-centric viewpoint.
- The course concentrates on service quality aspects of mobility.
  - Also AAA, security etc. need to be taken into account in designing real systems.
    - We shall only cursorily touch these issues.

Planned contents & draft schedule

1.	Introduction	Jan 13th
2.	Mobile Applications	Jan 20th
3.	Service Quality requirement characterizations	(Jan 27th)
4.	Challenges of mobile environment	(Feb 3rd)
5.	Mobility and QoS in GPRS	(Feb 10th)
6.	Mobility and QoS in 3GPP systems	(Feb 17th)
7.	Mobility and QoS with Mobile IP	(Feb 24th)
8.	Mobile IP QoS enhancements	(Mar 3rd)
9.	Edge mobility	(Mar 10th)
10.	Inter-system mobility	(Mar 17th)
11.	End-to-end QoS management	(Mar 31st)
12.	Summary	(Apr 7th)

Dates in parentheses to be confirmed

Course material

- No obligatory course books.
  - Pointers to further material will be included into handouts.
- For more information, the following books are useful:
  - D. Wisely, P. Eardley, and L. Burness: IP for 3G, John Wiley & Sons, Chichester, England, 2002.
  - C.E. Perkins: Mobile IP – Design principles and practices, Addison-Wesley, Reading, U.S.A, 1998.
  - H. Holma and A. Toskala: WCDMA for UMTS, John Wiley & Sons, Chichester, England, 2000.
  - V. Räisänen: Implementing Service Quality in IP Networks, John Wiley & Sons, Chichester, England, 2003.
- Standardization material will be referred to where appropriate.

Who's who in standards

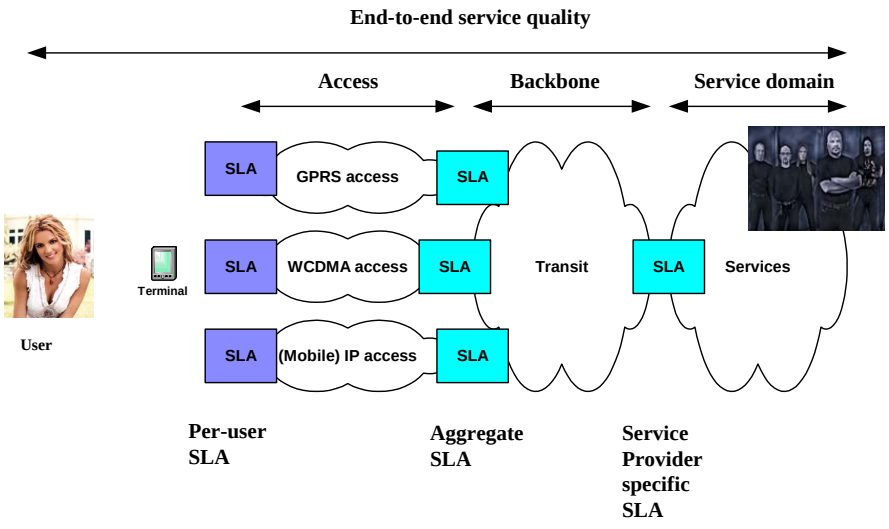
- **Internet Engineering Task Force (IETF)**
  - Standardization of Internet protocols, such as TCP, UDP, SCTP, RTP, SIP, …
  - Does not standardize architectures.
- **ETSI/Third Generation Partnership Project (3GPP)**
  - Standardization of 3rd generation mobile networks, including architectures and QoS models.
- **ETSI/TIPHON**
  - Originally IP telephony related standardization, including architecture and QoS model.
- **ITU-T**
  - Extending towards Internet technologies.

Service quality

- Term “Quality of Service (QoS)” is not well-defined.
- Terms used in this course:
  - **End-to-end service quality**: the result that the user of the service can observe.
    - Affected by all links in the end-to-end service delivery chain.
    - Also affected by psychological factors (e.g., use situation).
  - **Service quality support mechanisms**: the means of providing controlled end-to-end service quality
- End-to-end service quality is a result of service quality support mechanisms used by different parties.
- Typically devices such as Service Level Agreements (SLAs) need to be used to provide end-to-end service quality.

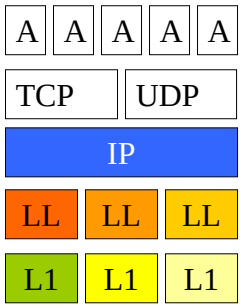
[ITU-T Rec. G.1000, Räisänen Ch. 2]
[Bouch *et al.*, *Of Packets and People…*, in *Proc. IWQoS'00*.]

Service quality, cont'd



IP as the convergence layer

- IP provides unifying layer between diverse applications and different kinds of link layer technologies.
  - Currently IPv4, but eventual transition to IPv6 is mandated by growth in the number of IP addressable devices.
- Tasks of layers:
  - L4: multiplexing, reliability, error detection.
  - L3: routing, IP QoS support, IP mobility.
  - L2: interfacing to L1, LL QoS support, LL mobility.
  - L1: provisioned or dynamic throughput.



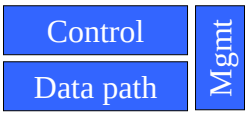
Internet design principles

- What is described below is the traditional Internet “mindset”.
- Design principles:
  - Connectivity.
    - Irrespective of access technology.
    - Interoperability important.
  - End-to-end principle.
    - Much of the responsibility for end-to-end functions is with the endpoints.
      - E.g., TCP.
  - Layering.
- Challenges have arisen due to enlarged area of application of IP.
  - Mobility
  - Wireless networks

[Wisely *et al*, Ch. 3]

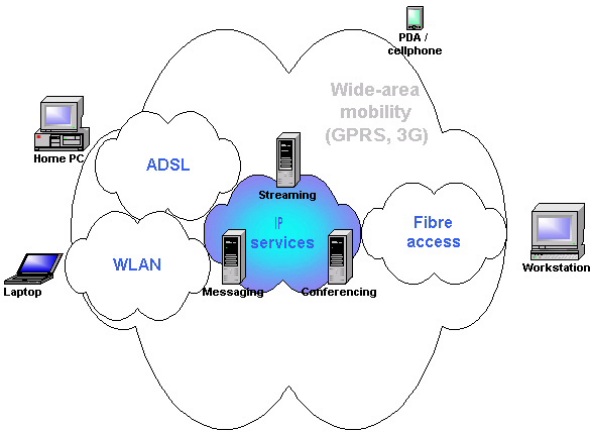
About layers and planes

- Recent trend has been moving more of connection control functionality to IP layer.
- Example 1: IP over PPP (modem line)
  - Call set-up signalling using ISDN or POTS protocols.
  - PPP negotiation by user client and modem server.
- Example 2: Mobile IP based system
  - AAA signalling uses IP-based protocols.
- User data plane and control plane exist logically in both cases.
- In example 2, IP is used as *signalling bearer*.



Multi-technology access to IP services

•IP in the endpoint.
•IP-based services.
  •SIP as an enabler.
•Access technologies support end-to-end IP:
  •Cellular & ADSL: tunnelled IP.
  •Fibre access: pure IP routing.
  •WLAN + mobile IP: IP-based mobility.



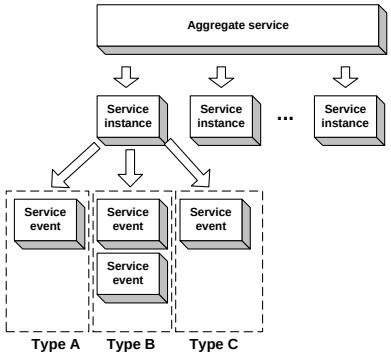
Some notes about IP-based services

- In IP environment, service creation is more flexible than in Intelligent Networks environment of POTS.
  - SIP provides means for subscriber availability and capability information exchange.
  - Provides building blocks for Virtual Home Environment (VHE) across technology boundaries & terminals.
  - Does not try to encompass all service provision aspects.
- Carrier-class features need to be implemented for certain IP services such as telephony: high availability, reliable and understandable charging, security, …
  - 3GPP R5: IP Multimedia Subsystem (IMS)
- Generally, services to which end user subscribes, require better support.

[Wisely *et al*, Ch. 4]

Some service-related vocabulary

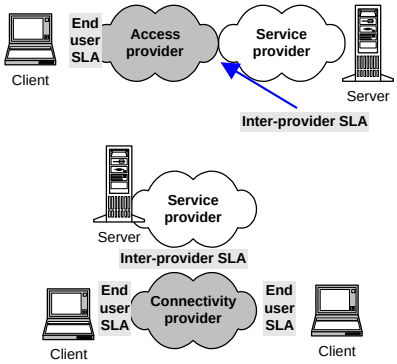
- Aggregate service.
- Service instance.
- Service event.
- Service event type.
- **Example**: ACME industries Ltd. sells kryptonite detectors on-line.
  - Clark Kent instantiates ACME's aggregate HTTP service.
  - Service events: watch streamed video ad; fetch price data; send credit card number; get reference number for order.



[Räisänen Ch. 2]

About service providers

- Service providers can have two kinds of rôles: providers of content services or connectivity services.
- **Content services**:
  - HTML, streaming, E-commerce, animation of kittens singing Led Zeppelin.
- **Connectivity services**:
  - (Multimedia) telephony
  - Instant messaging
  - Presence



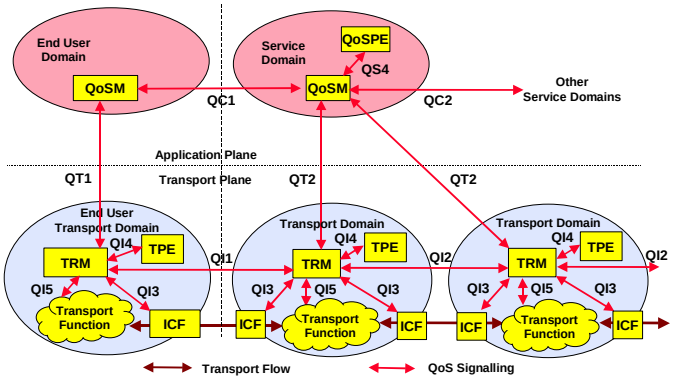
[Räisänen Ch. 2]

Rôles of operators

- Traditionally, POTS operators have provisioned both the access and the services.
- Recent trend has been towards technologies allowing decoupling of services from access.
- **Service operators**
  - Provide services
  - For connectivity-type services such as VoIP, interface to peer service operators.
- **Access network operators** provide access to Internet.
  - Take into account service specific requirements
- **Transport operators** provide transit network connectivity.

Example: ETSI TIPHON model

- Originally developed for IP telephony but can be applied more generally.
- Deliverable: ETSI TS/TIPHON 101 329-3, available from http://docbox.etsi.org/TIPHON/TIPHON/07-drafts/wg5/_Published.



Services

- Services can be provided:
  - On subscription basis (either to a service or set of services).
  - Based on request from end user or other service provider.
  - Free of charge.
- When charging involved:
  - Reliable user service flow identification required.
  - It shall be possible to either ask for per-instantiation service quality support explicitly or provide necessary service quality support "implicitly" based on SLAs.
- SLAs may be used towards peer service providers, network operators, and end users.
  - Per-session service quality signalling can still take place.

Networks

- Suitable service quality support mechanism available
  - Per-node mechanisms
    - Capacity reservation
    - Prioritisation
  - SQS instantiation control.
- Service quality instantiation may be controlled by terminal, network or server.
- End-to-end service quality handled with SLAs towards other operators, service providers & end users.
- Traffic engineering may be used to optimise network configuration.

Endpoints

- Endpoint instantiates the service
  - E.g., SIP, RTSP, HTTP, WAP.
- Endpoint may indicate its own capabilities
  - E.g., SDP: VoIP codecs available.
  - Alternative: network deduces terminal capabilities indirectly.
- Endpoint may request service quality support instantiation
  - E.g., RSVP, PDP context activation signalling.
  - Alternative: SQS type deduced indirectly
    - Defined in subscription.
    - Defined in SLAs towards service providers.
    - …

Summary

- If network operator is separate from service provider, neither of them can alone provide service quality guarantee.
- Two possibilities:
  - End users subscribe to service provider
    - Service quality handled via SLAs towards network provider and/or per-session signalling.
  - End users subscribe to network provider for Internet access
    - Network provider subcontracts a selection of services from 3rd party service providers and arranges for service quality support with SLAs and/or per-session signalling.
- Roaming between operators.

More information

- QoS definitions: ITU-T recommendation G.1000, 3GPP deliverable 22.105.
- TIPHON QoS model: ETSI TR/TIPHON 101 329-3.
- SLAs:
  - TeleManagement Forum
  - IETF RFC 3260 (DiffServ).