HELSINKI UNIVERSITY OF TECHNOLOGY

Next Generation Networks (NGN) ITU-T perspective

Lecture for S-38.3180 QoS in the Internet

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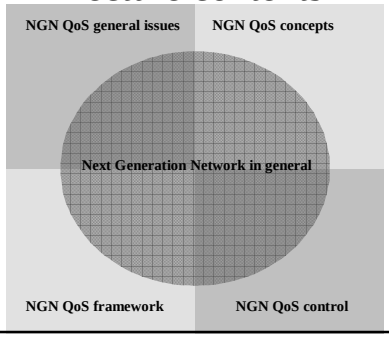
Knowledge gained in this lecture

- After this lecture you will
  - Know what Next Generation Networking aims and targets for, and how it approaches networking
  - Be able to explain the point of view of NGN standardization and how it differs from many other networking standardization efforts
  - Be able to explain the NGN architecture in detail
  - Understand and be able to explain the NGN QoS objectives and concepts
  - Understand and be able to explain the NGN QoS framework, its processes and process levels
  - Be able to explain the NGN approach to QoS control
  - Be able to put into perspective the service architecture standards (DiffServ and IntServ) and NGN

NGN in a slide

- NGN is a ITU-T standardization effort
  - It is something of a network and service architecture -> quite high and abstract in many cases
  - Work is ongoing, so the info in these slides is sure to evolve
- NGN is thought to be in existence when all networks and services have converged (cf. to lecture on convergence in S-38.3192).
- NGN utilizes the existing service/application/network infrastructure and introduces mechanisms that enable smooth layered (horizontal) coupling of all the different technologies
  - No need to re-invent all services/applications/protocols/ networks.
  - However, a lot of need to invent the glue to hold everything together
- Other similar efforts exist: typically they vision All IP Networks (AIPN)

Lecture contents

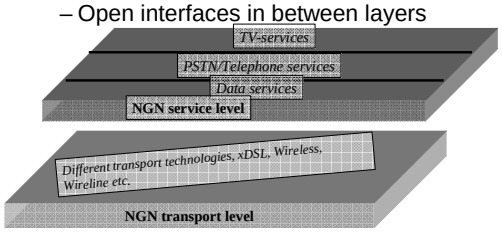


Contemporary Networking

- Most services (and traffic they produce) are carried in (at least logically) separate networks
  - TV, phone services, data services
    - Interaction between networks is challenging, to say the least (however, small steps are taken, e.g., VoIP vs. PSTN).
- These networks are usually ”vertically integrated” meaning that they work well for the purpose for which they were designed.

NGN – future of networking

- Horizontally integrated (ITU-T Y.2011)
  - Open interfaces in between layers



NGN targets & goal

- Target of NGN network is to ensure that all elements required for interoperability and network capabilities support applications globally across the NGN while maintaining the concept of separation between transport, services, and applications.
  - Global application support
  - Separation of transport, service and application
- NGN facilitates convergence of networks and convergence of services

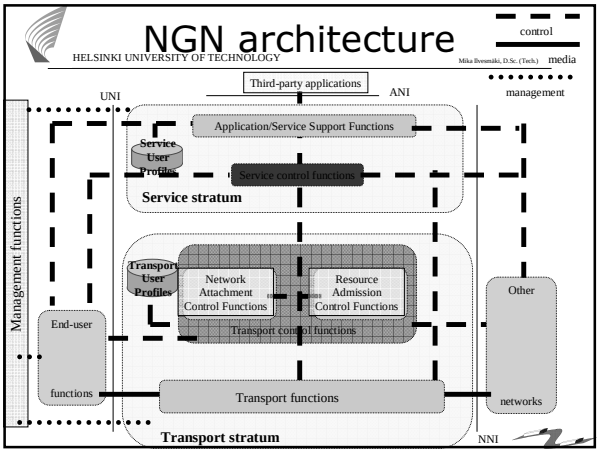
NGN fundamental characteristics (ITU-T Y.2001)

- NGN is based on **packet-based transfer** of all data (as opposed to the partly circuit-switched networks of today)
- **The control** of network capabilities, call/session -properties, and application/ service **is separated** (meaning one interface to all networks/services).
  - Support for a wide range of services, applications and mechanisms based on service building blocks (including real time/ streaming/ non-real time services and multi-media services)
- Broadband capabilities with **end-to-end QoS**
  - Decoupling of service provision from network, and provision of open interfaces
  - Unified service characteristics for the same service as perceived by the user
- **Interworking with legacy networks** via open interfaces
- **Generalised mobility** support
  - Both personal and terminal
- Unrestricted access by users to different service providers
  - A variety of identification schemes
- **Support of multiple access technologies**
- Complies with **all** regulatory requirements
  - e.g. emergency communications, security and privacy

NGN architectural principles

- Open architecture
  - Control interfaces should be open to support service creation etc. by all
- Independent provisioning
  - Service provisioning separated from network operation
- Multiplicity
  - Support for multiple access technologies

NGN architecture



Summary of NGN

- A Next Generation Network is a packet-based network
  - that is able to provide telecommunication services,
  - that is able to make use of multiple broadband, QoS-enabled transport technologies
    - Resource and admission control
  - and in which service-related functions are independent from underlying transport-related technologies.
  - It accommodates legacy terminals and systems
- NGN offers unrestricted access by users to different service providers.
- Personal and Terminal Mobility
- **NGN provides for the separation of services and transport**
- **Policy and Regulation environments will be impacted by this change from Vertical to Horizontal environment**

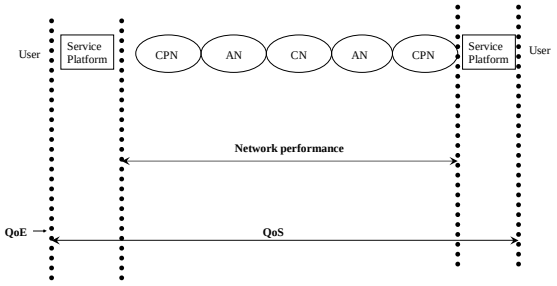
Basic QoS objectives in NGN

- End-to-end QoS support
- QoS across transport stratum (both access and core networks
- Taking into account the application resource requirements

QoS concepts in NGN

- QoE: Quality of Experience is the overall acceptability of an application or service as perceived subjectively byt the end-user
- QoS: (E.800) Collective effect of service performance which determine the degree of satisfaction of a user of the service
- NP(Network performance): I.350 ”NP is measured in terms of parameters which are meaningful to the network provider. NP is defined independently of terminal performance and user actions.
- NGN ”overall QoS” combines all these.

QoS concepts clarified



QoE, QoS and NP compared

QoE	QoS	Network performance
User oriented		Provider oriented
User behaviour attribute	Service attribute	Connection/Flow element attribute
Focus on user-expected effects	Focus on user-observable effects	Focus on planning, development, design, operations & maintenance
User subject	Between service access points	End-to-end or network elements capabilities

NGN IP network QoS classes

- Six different classes (0:Best 5: Worst)
  - Class 0: Transfer delay 100ms, delay variation 50ms, loss: $10^{-3,}$ error: $10^{-4.}$ Suggested UMTS/3G mapping: Conversational
  - Class 1: Delay 400ms, variation 50ms, loss: $10^{-3,}$ error: 10^{-4} Suggested UMTS/3G mapping: Streaming
  - Class 2: Delay 100ms, variation unsepcified, loss: $10^{-3,}$ error: 10^{-4} Suggested UMTS/3G mapping: Interactive
  - Class 3: Delay 400ms, variation unspecified, loss: $10^{-3,}$ error: 10^{-4} Suggested UMTS/3G mapping: Interactive
  - Class 4: Delay bound 100ms, Delay variation 50ms, loss: $10^{-3,}$ error: 10^{-4} Suggested UMTS/3G mapping: Interactive
  - Class 5: Everything unspecified, Suggested UMTS/3G mapping: Background

NGN QoS in heterogeneuous environments

- In practise, a packet path may include different transport technologies (WLAN, ATM, UMTS)
- The goal is to define QoS classes in these mixed L2-environments so that realised performance is expected not to be worse than if the path would follow single-technology-L2.
  - Initial requirement is to provide mappings from one QoS architecture (like DiffServ/IP) to another (like UMTS/3G)

QoS framework

- In order to achieve end-to-end QoS, NGN introduces a QoS framework model.
  - It aims to identify the processes and functions needed in QoS for both service and transport stratum
  - It is not an architecture as such, therefore implementation is not defined
- Framework is based on customer-provider relationship and it is related to service lifecycle
  - It has three processes: Subscription/Provisioning process, Invocation (Dynamic QoS) –process and after sales – process
    - Subscription/Provisioning and After Sales –processes are management oriented and Invocation happens on a dynamic control plane
  - Processes are divided into six levels + added seventh level for transport functions (network element functions)

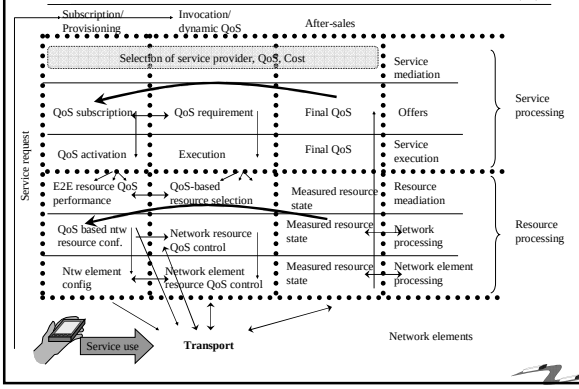
Framework processes

- Subscription
  - This process is in charge of dimensioning, deployment, network configuration management
- Invocation
  - This process is in charge of service and resource control in real-time/ on demand
- After-sales
  - This process is in charge of SLA measurements, monitoring, network performance status, fault management.

Framework process levels

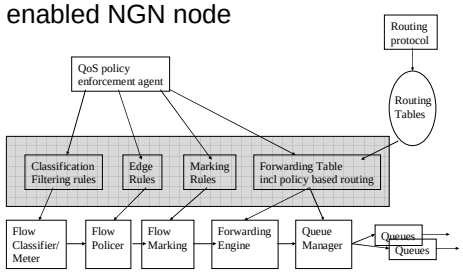
- Service mediation (”Front office”)
  - Indicates the main attributes of services to the customer.
- Offers (”Back office”)
  - Bundles services according to customer requests
- Service execution
  - Plan and develop the requested service
- Resource mediation
  - Intermediate level between service execution and resource processing (NGN basic idea is to separate these two)
  - Translates service parameters into resource parameters
- Network resource processing
  - Path computing, constraint computing
- Network element resource processing
  - Routing, individual link configurations etc.
- Network element
  - Transport functions (policing, filtering etc.)

Framework model



NGN nodal architecture

- The general architecture of a QoS-enabled NGN node



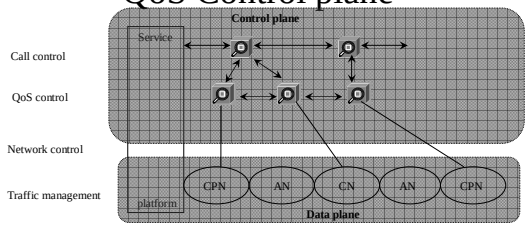
NGN and QoS control

- Resource and admission control functions provide QoS control in NGN networks
  - Admission control implements checks for authorization, SLAs, policy, priority and service availability
- RACF is a necessary element for resource negotiation and allocation between service control functions and transport functions (cf. to NGN architecture).

QoS control framework in NGN

- Control components at different levels
  - Call control, session level QoS negotiation
    - E2E QoS service control
  - QoS control, QoS parameters between routers, independent of the layer 2 technology
  - Network control, determines layer 2 parameters based on layer 3 QoS parameters
  - Traffic management, to direct different types of traffic to appropriate networks

QoS Control plane



Summary of NGN QoS

- End-to-end QoS
  - Implies QoS control
  - Starts from customer – provider dichotomy
- Defines concepts, frameworks and general functional requirements
  - Does not take strong views on implementation
- Aims to separate transport, services and applications
  - Goal is to offer all applications network access independent of the underlying service and transport infrastructure

Sources of information

- NGN-GSI: **NGN Global Standards Initiative in ITU-T**
  - http://www.itu.int/ITU-T/ngn/index.phtml
- NGN-MFG: **NGN Management Focus Group**
  - http://www.itu.int/ITU-T/studygroups/com04/ngn-mfg/index.html