Next Generation Networks- Next Generation Internet and corresponding regulatory Issues
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  - Next Generation Internet (NGI)
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Introduction (I):
Drivers of the evolution of telecommunication networks

- Demand for new services by users
  - Videoconference, VoIP
  - WEB2, Streaming
- Technological advances
  - Mobile Access (GSM, UMTS, WiFi, WIMA)
  - Fixed Access (xDSL, Cable, PLC)
  - Trunk Networks (DWDM, Soft-Switching, IMS)
- Market issues
  - FMI, Seamless Services
  - Service Bundling (Triple-Quadruple Play)
  - OPEX reduction by Integration
  - ARPU increase and churn rate reduction by Service Basket

Introduction II)
Service Evolution

Service Bundling trend: operators offer packages of unified services

- More than 50% of the world users would say yes to bundling services [Cambridge-2005]
Introduction III):
Service Evolution

- **Traffic Migration**, [Visser-2006]
  - Trend in traffic migration from fixed access to mobile one (wireless)
- **Intention of Access** [Cambridge-2005]
  - Trend in using the mobile terminal first

Evolution of the Network Architectures (I)

- The current objective of network development is “Integration and Convergence” which considers multiples aspects mainly:
  - Services integration
  - Network evolution for dedicated networks to only one common platform
  - Fixed mobile convergence
Evolution of the Network Architectures (II)

• The operators react to this development in different forms:
  • Former incumbent operators are going to implement a new network named Next Generation Network which provides the integration of all existing networks with its current services and the possibility to offer new mainly multimedia and content based services
  • Mobile operators are moving from 2G to 3G mobile networks offering also new services as multimedia and content access
  • Internet Transport- and Internet Service Provider are going to upgrade their best-effort internet platforms in direction to Next Generation Internet to offer new multimedia services

Evolution of the Network architectures (III)
NGN (I)

- First steps of integration starts in the 80 with the ISDN and in the 90ties with the BA-ISDN under ATM technology
- For the legacy networks the ITU defined first for ATM based broadband networks a cube model composed on three plans
  - User information
  - Control
  - Management

NGN (II)

general architecture model

- For NGN the legacy ITU concept is extended by a model with five vertical layers
- the core transport and control layer forms the kernel of NGN.
- Different aggregation and access networks can connect to the core part standardized interfaces
- xDSL technology and a corresponding access network is the most important part for wire access using at least part of the legacy SAN
- GPRS, UMTS, WIMAX are access technologies for wireless access
**NGN (III)**

**general architecture model**

- The extension of the legacy cube model to the NGN core architecture results two main layer each of them subdivided:
  - **NGN Service**
    - Proper services as access to applications over middleware
    - Service control and management example S-CSCF of the IMS architecture in relation with the HSS
  - **NGN transport**
    - Transport control, policy and management functions example P-CSCF in relation with PDF
    - Proper transport function (transfer functional area)

**NGN (IV)**

**IMS extensions**

**IP Multimedia Subsystem (IMS)**

- is an architecture for the control plan which provides a standardized access to
- an IP based transport plan situated below
- a service and application plan situated above
- inter-works with existing legacy voice and data networks for both fixed and mobile users.
- facilitate the paradigm of fixed mobile convergence
- substitute the earlier sof-switch concept
NGN (V)

evolution path

<table>
<thead>
<tr>
<th>Plan</th>
<th>Legacy</th>
<th>Current</th>
<th>Emergent</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>CCCn°7 SP, STP</td>
<td>Call control by centralized soft-switch</td>
<td>IMS with call control via P/IS-CSCF</td>
<td>?</td>
</tr>
<tr>
<td>Transport logical layer</td>
<td>Circuit o packet switch functions</td>
<td>IP, ATM</td>
<td>IP, MPLS</td>
<td>IP, GMPLS</td>
</tr>
<tr>
<td>Transport physical layer</td>
<td>SDH</td>
<td>SDH/WDM</td>
<td>NG-SDH/DWDM</td>
<td>OTN</td>
</tr>
</tbody>
</table>

Development of the different layers for Telecom Network architectures

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NGN (VI)

résumé

As a resume the NGN core concept claims to provide a Network platform which:

- provides access to services including Telecommunication Services
- is able to make use of multiples broadband, QoS-enabled transport technologies
- provides service related functions that are independent from underlying transport-related technologies.
- offers unrestricted access by users to different service providers.
- supports generalized mobility allowing consistent and ubiquitous provision of services to users
NGI strategy (I)

Next Generation Internet NGI is originally a concept to improve the current Internet by corresponding new protocols mainly

- Introduction of IPv6 which provides
  - Larger address scheme
  - Additional functions for privacy and security (IPsec)
  - Additional fields for identifying traffic classes for indicating traffic priorities and flow labels for future QoS differentiation
  - Other means already applied in IPv4 environments like
  - Multi Protocol Label Switching for routing packets over the fixed paths during a session

NGI strategy (II)

As IPv6 results difficult to implement in the world-wide public Internet additional protocols are used already under IPv4 like

- DiffServ for traffic engineering and QoS differentiation
- Higher layer protocols for real time service like RTP, RTCP
- Signaling protocols for session establishment like SIP, SDP where the functions are not centralized but distributed over the periphery units like Proxies and the proper User equipment
- Special functional units for incrementing the security and hidden internal SIP addresses like Session Media Gateway Controller
Summarizing NGI

- is a concept which support Multi-Service/Multimedia and QoS
- Describes the evolution of public best Internet in the direction of a QoS managed Internet
- Considers similar like best effort Internet the integration of multiples provides under open standards from the IETF
- Use for access and service control a distributed intelligence over end equipment like user terminals application servers but also additional proxies and servers at the net periphery

NGI strategy (III)

NGN - NGI comparison

<table>
<thead>
<tr>
<th>Attribute</th>
<th>NGN</th>
<th>NGI</th>
</tr>
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<tbody>
<tr>
<td>Target Network</td>
<td>EMI universal Broadband-Network</td>
<td>Extended Internet with QoS- and Capacity Management</td>
</tr>
<tr>
<td>Functional distribution</td>
<td>Central and separated control plan</td>
<td>Distributed server and end equipment</td>
</tr>
<tr>
<td>Complexity of the end-equipment</td>
<td>Small – medium</td>
<td>Medium – high</td>
</tr>
<tr>
<td>Main standard institutions</td>
<td>ITU, ETSI (IETF)</td>
<td>IETF</td>
</tr>
<tr>
<td>POTS and legacy PSTN/ISDN services</td>
<td>From the beginning</td>
<td>Only basic services which are improved depending on the market situation</td>
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<tr>
<td>Envisaged layer 3 protocol</td>
<td>IPv6</td>
<td></td>
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<tr>
<td>Kernel equipment</td>
<td>Terra-bit-Router and DWDM</td>
<td></td>
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<tr>
<td>Capacity management</td>
<td>ASON ?</td>
<td>GMPLS</td>
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<tr>
<td>Innovation steps</td>
<td>Integration of PSTN/ISDN and Data Service, new multimedia services</td>
<td>VoIP and Multimedia integration in best effort Internet, Evolution in the direction of NGI</td>
</tr>
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</table>
Regulatory Issues for NGN (I)

• The strong vertical integration of Access, Transport, Control, Service-Application and Content and the horizontal integration in the transport implies new questions in the field of Telecom and Media Regulation

• There are some suspicions that this integration increases the power of the dominant network operator(s) which might affect mainly small ISP and service-application and content providers without proper infrastructure; the literature indicates the following aspects:
  • IPTV is currently offered as “walled garden” hence a user can stream TV only offered by its provider but not from other
  • Exclusive offer of important Mass Events like e.g. “Football or Tennis league”
  • in case of proper content providing by an integrated company

Regulatory Issues for NGN (II)

• The current regulatory philosophy is that the best regulator is the proper market meanwhile competition works

• Hence Regulation has to concentrate to expected segments where competition does not work (competition bottlenecks)

• The main competition bottlenecks in legacy networks requiring were and are:
  • Call termination
  • Interconnection
  • First (and in some cases second) mile
Regulatory Issues for NGN (III)

- Competition bottlenecks in NGN and NGI might arise mainly in NGN due to
  - Its implementation only by operators with significant market power (SMPO)
  - Its strong vertical functional integration
  - Its horizontal integration in the transport plan
  - Its centralized control plan
  - Its infrastructure which provides a full covering from the first to the fourth mail
  - Differentiated QoS requirement for the service offering

- Regulation for NGN and its corresponding services (Triple- and Quadruple play) is still in its initial steps but some first steps studies are under way

Regulatory Issues for NGN (IV)

<table>
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Cost model for capacity bottleneck regulation in NGN (I)

- Competition bottleneck in capacity might arise in the first and the second mail of the NGN infrastructure.
- Hence mainly Tier 3 but also some Tier 2 ITP/ISP require wholesale service for xDSL access covering mainly the first and the second mail in the NGN infrastructure but in some cases even the third one.
- This wholesale service, named by the European Regulator Group (Broadband) Bitstream Access Service BAS requires the consideration of QoS.
- First studies indicates that an SMPO might get a strong integration benefit providing virtual tunnels with different QoS parameter values under a DiffServ traffic engineering scheme mainly when the traffic demand for higher QoS services (e.g. real time) is small against the traffic resulting from pure data and best effort services.
- Hence a cost model is required which calculates the cost not only under pure capacity requirement but taking into account the QoS parameter.

Cost model for capacity bottleneck regulation in NGN (II)

- A corresponding TELRIC model is proposed which considers as smallest network elements is modeled by a proper queuing systems composed by a queue and a server (processor- or transmission system capacity).
- The model consider currently:
  - Traffic corresponding to the call (session) layer
  - Traffic corresponding to the packet (IP) layer
  - Call session layer consider both pure change- as burst traffic applying an extended Erlang-B
  - Packet Layer consider currently a pre-empty priority queuing model baed on a Poisson arrival and the first two statistical moments of the packet length (three parameter model)
- An extension to a general packet arrival stream is under work (four parameter model).

For more details see Hackbarth, García, Rodríguez, TELRIC-Cost model under QoS consideration for application in NGN and NGI; Euro-NGI Workshop on Socio-Economic Aspects of Next Generation Internet, Santander, June 2007,

http://www.fmat.unican.es/...
Conclusion and future work I

The contribution showed that:

- The main drivers which changed current network architectures and corresponding implementation result from traffic migration, service and fixed mobile integration and new multimedia service baskets from joining IT with Telecommunication
- The transition from legacy PST/ISDN, PSDN to the Next Generator Network is provided from SMPO while from best effort Internet to Next Generation Internet mainly from pure ITP/ISP
- NGN provides a completely separated control plan which controls service access and QoS parameter for an All IP transport layer situated below and from above the service and content layer by open interfaces
- NGI provides a distributed control plan by external proxy servers and intelligent end equipment and provides QoS by some protocol enhancements in the transport layer (MPLS, DiffServ etc.)
- the vertical integration of Content/Applications, Services, Control, transport and access layer might provide new competition bottlenecks which requires corresponding regulation at national and European level
- mainly NGN implemented by SMPO might get under some circumstance an increasing market power

Conclusion and future work (II)

• Future work on network level
  - Identifying possible competition bottlenecks in network capacity mainly the access and interconnection part
  - development of cost and pricing models which considers differentiated QoS parameter values mainly for first and second mile competition bottleneck
  - improvement of the TELRIC model which considers QoS differentiation by a non pre-empty queuing system with K queues corresponding to K services classes
  - study of wholesale BAS cost at a geographical level of a nation NGN infrastructure applying a corresponding TELRIC models under calculating a corresponding network configuration (bottom up approach) considering the traffic resulting from a complete services set, traffic
Thank for your attention

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