Next Generation Networks- Next Generation Internet and corresponding regulatory Issues

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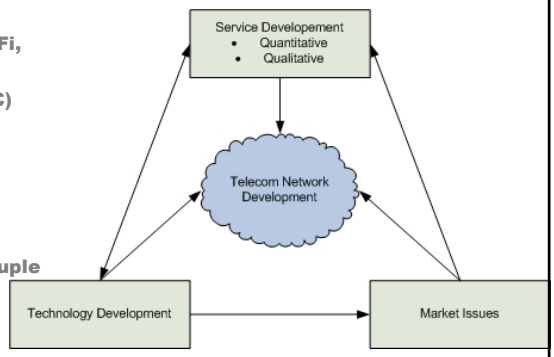
Contents

Introduction (I):

Drivers of the evolution of telecommunication networks

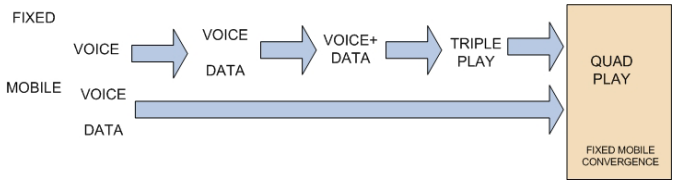
- **Demand for new services by users**
  - Videoconference, VoIP
  - WEB2, Streaming
- **Technological advances**
  - Mobile Access (GSM, UMTS, WiFi, WIMA)
  - Fixed Access (xDSL, Cable, PLC)
  - Trunk Networks (DWDM, Soft-Switching, IMS)
- **Market issues**
  - FMI, Seamless Services
  - Service Bundling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



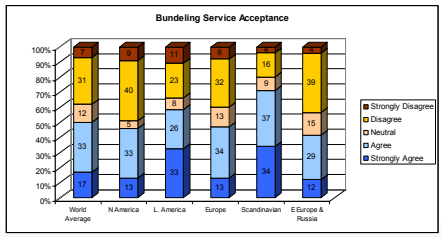
Introduction II)

Service Evolution

Service Bundling trend: operators offer packages of unified services

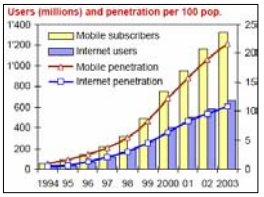


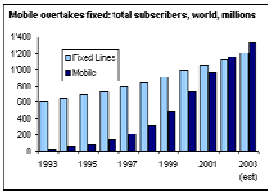
- **More than 50 % of the world users would say yes to bundling services [Cambridge-2005]**

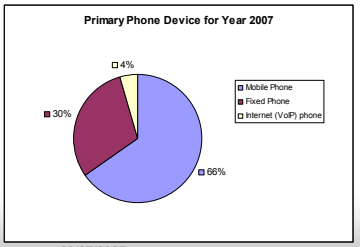


Introduction III):
Service Evolution

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







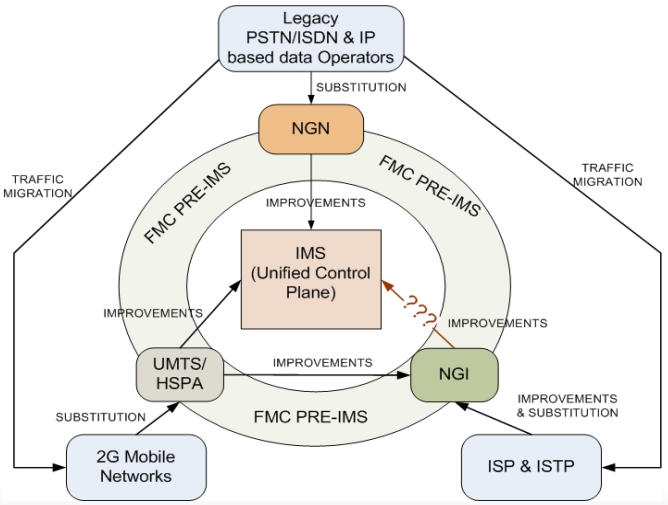
Evolution of the Network Architectures (I)

- **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)

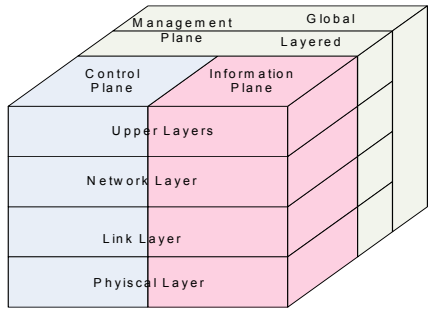
- The operators react to this development in different forms:
  - Former incumbent operators are going to implement a new network named **Next Generation Network** which provides the integration of all existing networks with its current services and the possibility to offer new mainly multimedia and 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

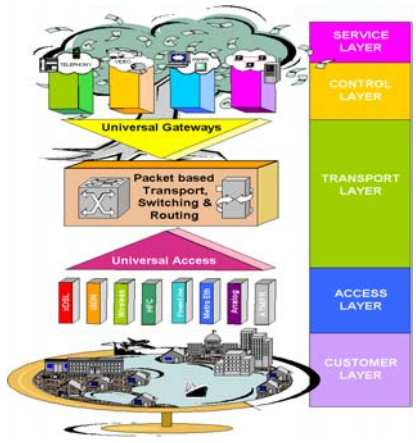


Generalization of the ITU reference model for ATM Broadband networks

NGN (II)

general architecture model

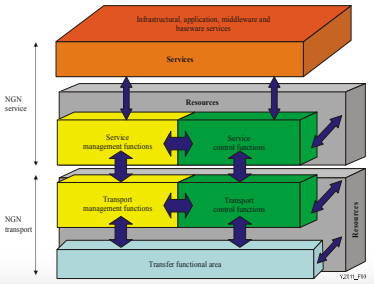
- For NGN the legacy ITU concept is extended by a model with five vertical layers
- the core transport and control layer forms the kernel of NGN.
- Different aggregation and access networks can connect to the core part standardized interfaces
- xDSL technology and a corresponding access network is the 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)



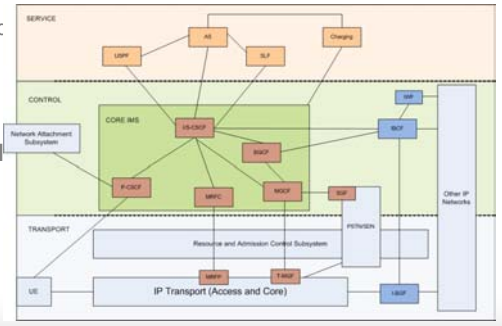
NGN (IV)

IMS extensions

IP Multimedia Subsystem (IMS)

in relation with NGN

- **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 soft-switch concept**



NGN (V)

evolution path

Plan	Legacy	Current	Emergent	Future
Control	CCCnº7 SP, STP	Call control by centralized soft-switch	IMS with call control via P/I/S-CSCF	?
Transport logical layer	Circuit o packet switch functions	IP, ATM	IP, MPLS	IP, GMPLS
Transport physical layer	SDH	SDH/WDM	NG-SDH/ DWDM	OTN

Development of the different layers for Telecom Network architectures

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

NGI strategy (III)

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 IEFT
- 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

<table>
<tr><td>Application and control</td><td>Voice video</td><td>WEB</td><td>e-mail</td><td>Conference</td><td>Multi-Media</td><td>B2B B2C</td></tr>
<tr><td>Managed transport part</td><td colspan="5">Empty or IP/MPLS managed VPN</td><td rowspan="2"></td></tr>
<tr><td>Best effort transport part</td><td colspan="5">Best effort Internet or empty</td></tr>
<tr><td>Access</td><td>Dial up modem</td><td>ADSL</td><td>GPRS/ UMTS</td><td>SDLS/ HDSL</td><td>FR/ ATM</td><td>Direct Access</td></tr>
</table>

NGN - NGI comparison

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

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)

Country	Regulator	SMPO	More information
United Kingdom	OFCOM	BT	www.ofcom.uk www.zdnet.co.uk/tsearch/Ofcom+21st+century+network.htm
Netherlands	OPTA	KPN	www.opta.nl http://www.t-regs.com/content/view/367/1/
Italy	AGCOM	Itatel	www.agcom.it www.networkmagazineindia.com/200609/analyst'scorner01.shtml
Germany	BNetA	DTAG	www.bundesnetzagentur.de www.icp.pt/streaming/estudogroebel28062007.pdf www.ntz-online.de/index.php?option=content&task=view&id=5358&Itemid=2

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 same 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 baaed 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.tlmat.unican.es/wpia76/

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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