



Mobile next generation network, Evolution towards 4G

**ITU/BDT Regional Seminar on Mobile and Fixed Wireless
Access for Broadband Applications for the Arab Region**

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Summary

I. UMTS releases example

II. IMS and NGN

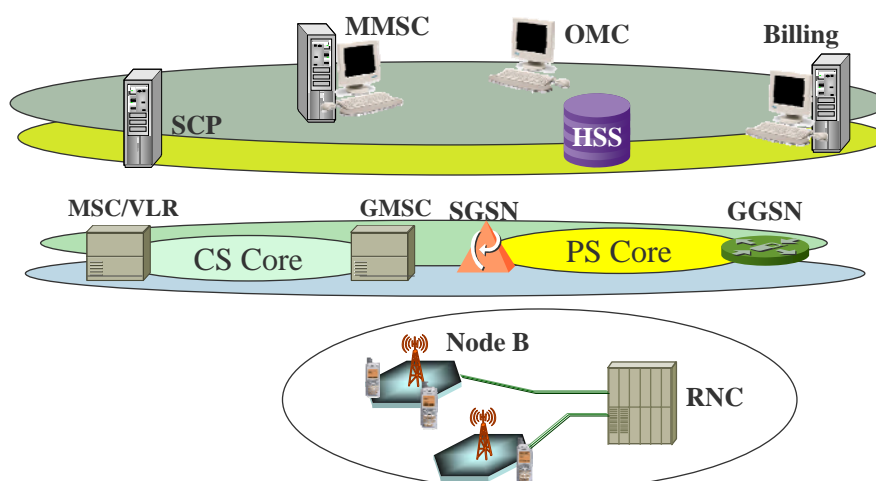
III. Evolution towards 4G

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I. UMTS releases example

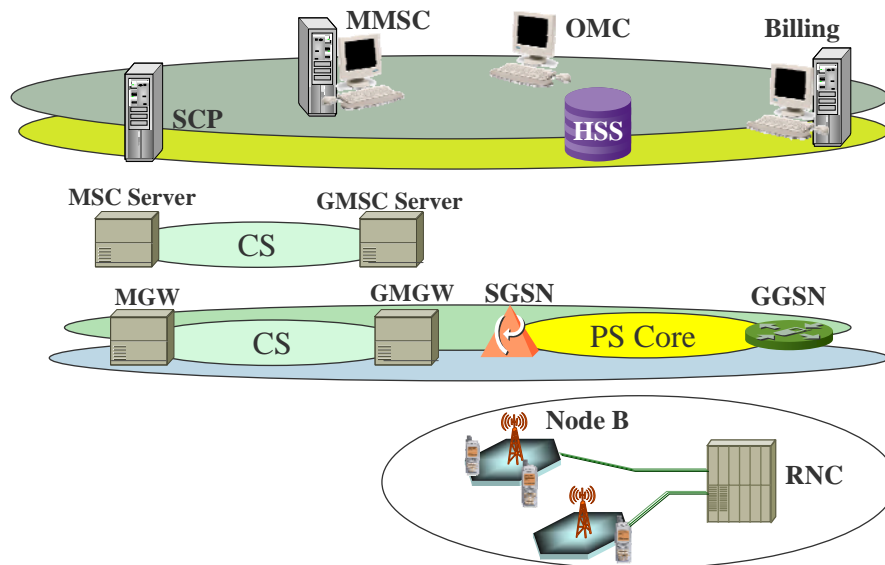
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UMTS Release 99



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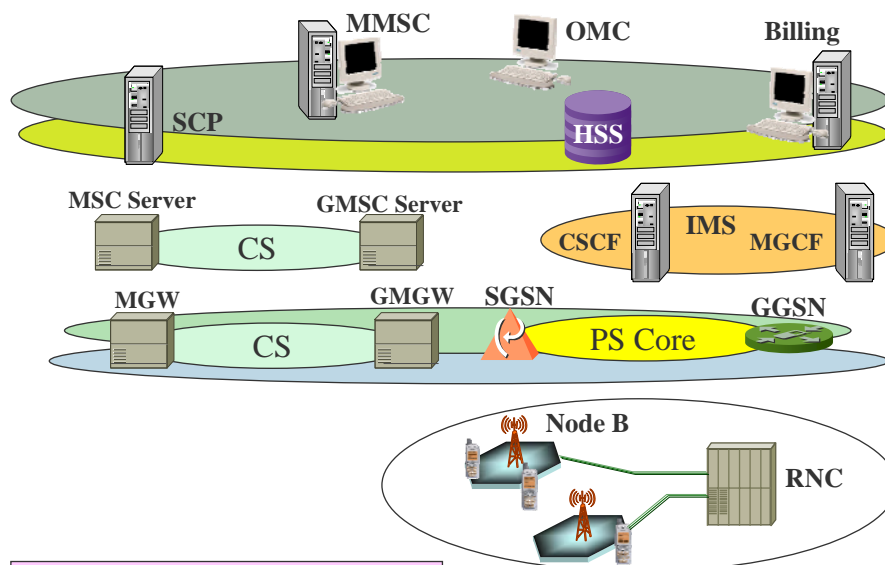
UMTS Release 99



Control and bearer plans separation for CS

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UMTS Release 5



Introduction of IMS, IP in RAN

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Core network evolution

2 main features

Gateway

- Border network
- Features:
 - Media resources,
 - Switching/Routing,
 - Media conversion,
 - Option: signaling.
- Examples: *Wireless Gateway, Fixed Gateway, IP Gateway*

Server

- Layer control
- Features:
 - Mobility management,
 - Call control,
 - Security,
 - Billing.
- Examples: *MSC Server, SGSN Server, CSCF (Call State Control Function), Media Gateway Control Function (MGCF).*

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UMTS services

Classes	Types of services	Constraints
<i>Conversational</i>	Voice, video	Real time
<i>Streaming</i>	File transfer (video sequence downloading)	Synchronism between entities
<i>Interactive</i>	Sessions (Web, databases access, ...)	Low BER
<i>Background</i>	SMS, e-mail, FTP	Low BER and low delay constraints

	Picocells	Microcells	Macrocells	Satellite coverage
<i>Area</i>	Buildings	Urban	Rural and suburban	Rural and suburban
<i>Bitrates</i>	2 Mb/s	512 kb/s	144 – 384 kb/s	9,6 kb/s
<i>Speed</i>	Low	120 km/h	500 km/h	120 km/h

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UMTS Release 5 features

- HSDPA (1 - 5 Mb/s mean throughput)
- CAMEL 4
- IMS (VoIP, chatt, games, *white shared board*, flexible billing, ...)
- *Wideband AMR* (larger band for voice)
- SIP (*call control*)
- Smart antennas
- OSA improvements (VAS offers from third parties, VHE eased)
- GTT (*Global Text Telephony*, real time conversation)
- *Extended streaming* (optimisation, 2 and 3D graphics, MIDI, ...)
- LCS improvements with A-GPS
- IP transport in UTRAN (IP-RAN) with DiffServ introduction
- End to end QoS enhancements
- MMS/EMS enhanced
- IuFlex (load sharing among core network nodes).

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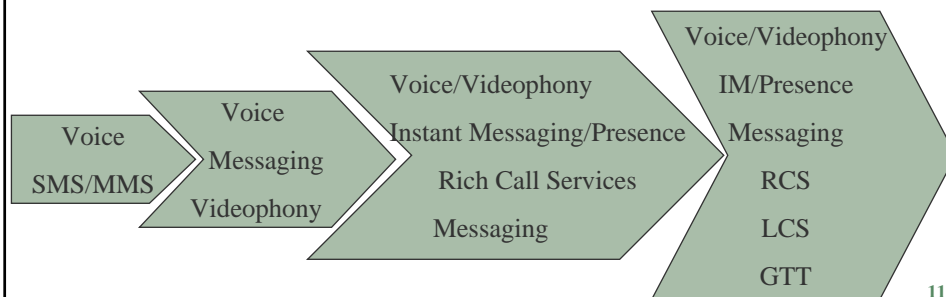
Release 6 features

- MBMS
- IMS phase 2 (access independant from access network UMTS, GERAN, WLAN)
- SES (*Speech Enhanced Services*): distributed speech recognition
- MIMO
- WLAN (*loose coupling*) with AAA features reuse, access with USIM
- Terminal management (configuration, performances, downloading)
- Presence and *Instant Messaging*

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Services evolution in UMTS R99/R4/R5/R6 networks

<i>Release</i>	<i>Services</i>
R99	MMS, streaming, LCS (cell), MExE, SAT, VHE,
R4	TrFO, VHE, OSA, LCS in PS and CS,
R5	VoD, IMS, HSDPA, Wideband AMR, GTT
R6	MBMS, IMS phase 2



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III. IMS and NGN

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NGN definition ITU

Rec. Y.2001 “**General overview of NGN**” (Dec 2004):

An NGN is a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which *service-related functions are independent from underlying transport-related technologies*. It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

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NGN definition

Separation of:

- *Access Layer*
- *Transport Layer*
- *Control Layer*
- *Service Layer*

with Control & Transport Layers being shared by:

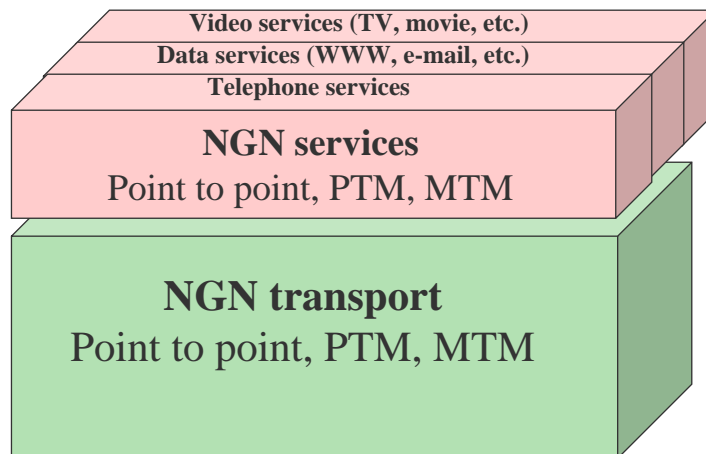
- different access types (RAN, Fixed...)
- service layers

with Packet (ATM, IP) Transport converging toward IP transport

for provision of Multimedia Services (Real Time, Presence, Messaging, Voice, Video, Data...)

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NGN convergence model



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IMS characteristics

Principles

- **QoS characteristics differentiation:** voice calls, videophony, associated to a multimedia session (streaming, IM, etc.)
- **Separation of the planes:** IP data and session control (SIP)
- **Independancy** from access network

R5

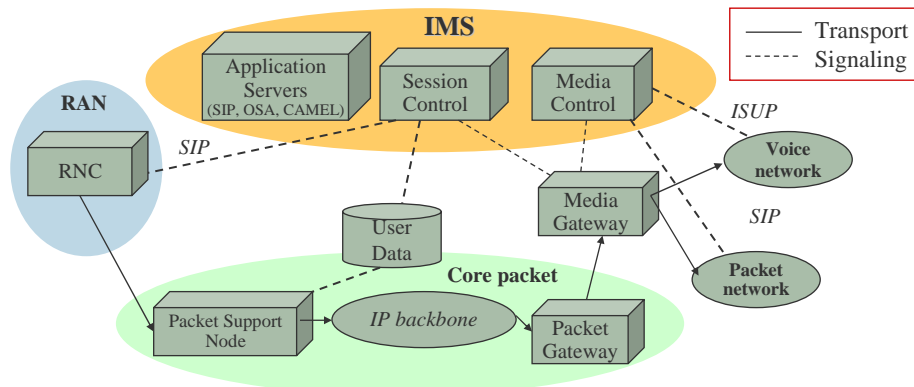
IMS for mobile networks
Packet GPRS, EDGE, UMTS & CDMA2000
Non real time services
Plate-form for **multimedia IP applications**
Based on **IETF specifications**

R6

IMS extended to fixed networks (xDSL, WLAN, cable, ...) with media gateway
Support of **services convergence** on fixed and mobile networks
(conversion CS voice traffic into IP)

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Componants and interactions between IMS and other networks



S-CSCF (*Call Status Control Function*): central IMS component;
SIP AS (*SIP Application Server*): provision of the logic associated with the VAS;
OSA SCS (*Service Capability Server*) gathers one or several features;
IM-SSF (*Inter-working Module*) : SIP-CAMEL interworking;
CSE (*Camel Service Environment*): SCP using CAMEL and GSM (GSM SCF) features;
HSS (*Home Subscriber Server*): same as HLR for IMS

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IMS in UMTS

Allows operators to have more control on the service level than with GPRS only:

- Service level awareness
- Correlation between the SIP application layer and the transport in PS domain
- Access to services in correlation with a subscription
- profile (e.g. basic, silver, gold...)
- Better control on the packet resources used
- **3GPP IMS Releases:**
 - Release 5: frozen since March 2003
 - Release 6: frozen since December 2004
 - Release 7: target to freeze end 2005

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IMS R5 features

*Allows the differentiation of QoS characteristics associated to a multimedia, voice call, or videophone session: conference calls, access to *streaming* contents, presence, video messaging, *Instant Messaging*, push services, content sharing, web browsing, file download,*

➤ *Flexible billing*: billing per service, connectivity, QoS, duration, destination – volume; billing per content, images, news, books.

➤ *Example*: add/suppress components such as video, audio, whiteboard on-line sharing.

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IMS R6 enhancements

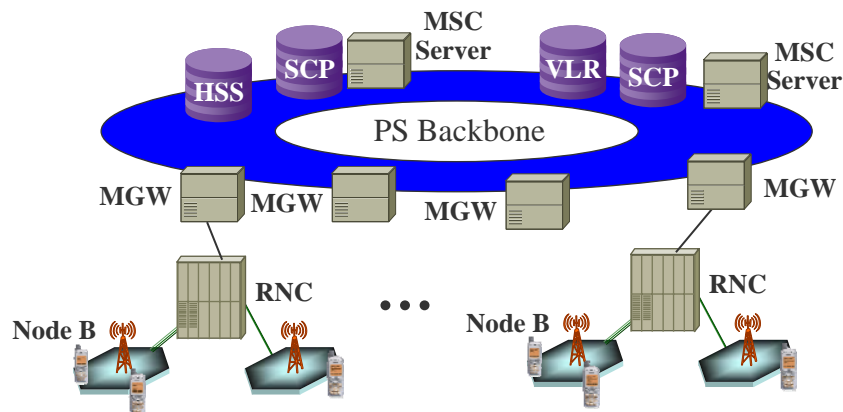
- *Identity portability*: Portability of the identities when changing operator
- *VoIP over HSDPA* (allows the use of IP for voice transportation during a handover with a better QoS during HO).

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Transition to NGN (1)

NGN advantages:

- Transport network simplification (common CS/PS backbone),
- No transit layer,
- Common signaling (signaling over IP, SIGTRAN),

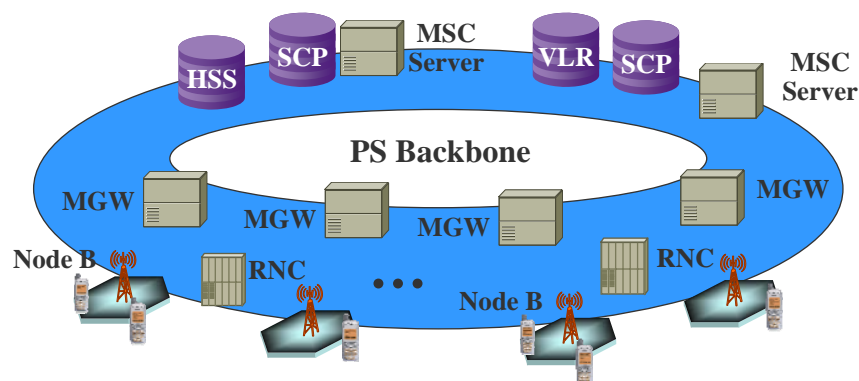


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Transition to NGN (2)

NGN advantages:

- Transport network simplification: R5 common CN/RAN backbone,



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IV. Evolution towards 4G

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4G - What is it?

- 4G = 4th Generation mobile communications
- 4G = B3G = Beyond 3rd Generation (UMTS, IMT-2000) mobile communications
- Foreseen to become available *after 2010*.
- ITU Recommendation ITU-R M.1645:

Systems beyond IMT-2000 will be realized by functional fusion of existing, enhanced, and newly developed elements of IMT-2000, nomadic wireless access systems and other wireless systems, with high commonality and seamless interworking.

= *mix of many interacting systems* is foreseen - not one standard.

- Targeted data rates (with wide area coverage and significant mobility) are in the area of *50 to 100 Mbits/s*.

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Motivations

- Wider Bandwidth
- Global mobility and service portability difficult due to different standards hampering
- Primarily Cellular (WAN) with distinct LANs'; need a new integrated network
- Apply recent advances with spectrally more efficient modulation schemes
- Need all all digital network to fully utilize IP and converged video and data

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Key 3G and 4G Parameters

<i>Attribute</i>	<i>3G</i>	<i>4G</i>
Major Characteristic	Predominantly voice- data	Converged data and VoIP
Network Architecture	Wide area cell based	Hybrid – integration of Wireless Lan (WiFi), Blue Tooth, Wide Area
Frequency Band	1.6 - 2.5 GHz	2 – 8 GHz
Component Design	Optimized antenna; multi-band adapters	Smart antennas; SW multi-band; wideband radios
Bandwidth	5 – 20 MHz	100+ MHz
Data Rate	385 Kbps - 2 Mbps	20 – 100 Mbps
Access	WCDMA/CDMA2000	MC-CDMA or OFDM
Forward Error Correction	Convolution code 1/2, 1/3; turbo	Concatenated Coding
Switching	Circuit/Packet	Packet
Mobile top Speed	200 kmph	200 kmph
IP	Multiple versions	All IP (IPv6.0)
Operational	~2003	~2010

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Definition

- Completely **new fully IP-based integrated system of systems and network of networks** achieved after **convergence of wired and wireless networks** as well as **computers, consumer electronics, and communication technology** and several other convergences that will be **capable to provide 100 Mbps and 1 Gbps**, respectively in **outdoor and indoor** environments, with **end-to-end QoS** and high **security**, offering **any kind of services at any time** as per user requirements, **anywhere** with **seamless interoperability**, always on, **affordable cost**, one **billing** and fully **personalized**.

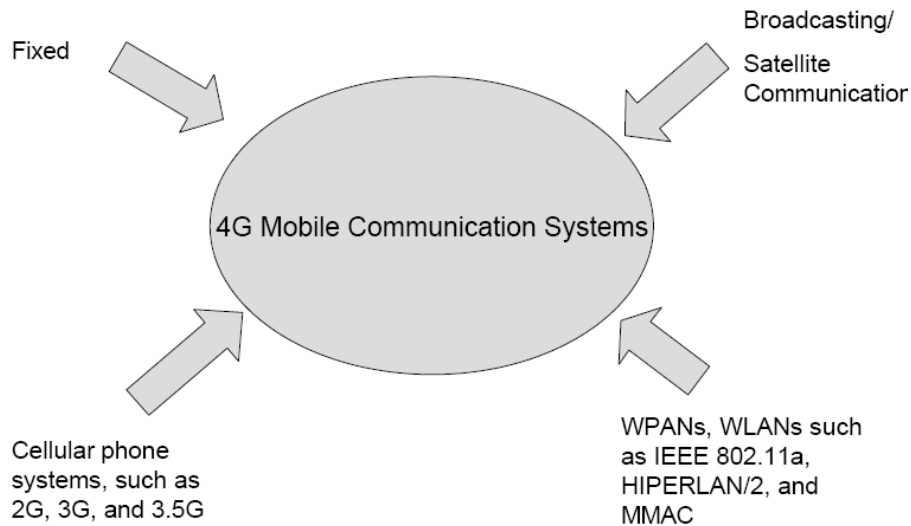
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Radio technologies for B3G systems

- MIMO (*Multiple-Input Multiple Output*) technology
- Link adaptation techniques
- Multi-carrier based modulation and access (OFDM/OFDMA)
- Iterative (multi-user) processing
- “Cross-layer” optimization and design principles
- Ultra-WideBand (UWB)...?

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Convergence is what 4G is about



Concluding remarks

- **4G, convergence:** networks, technologies, applications and services,
- Personalized and pervasive network to the users.
- Full IP and one unique core network.
- Services, applications, transport, access separation (NGN) approach.
- **Convergence** is the disruptive concept of 4th generation mobile networks.

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