Mobile Networks Evolution towards New Generation Networks

ITU-BDT Regional Seminar on Fixed Mobile Convergence and new network architecture for Arab Region

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Sami Tabbane

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Summary

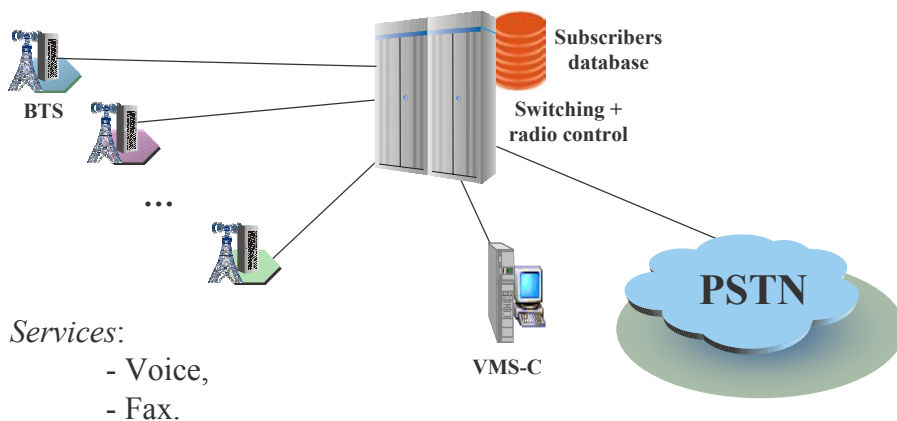## I. 2G mobile services evolution

II. UMTS releases example

III. IMS and NGN

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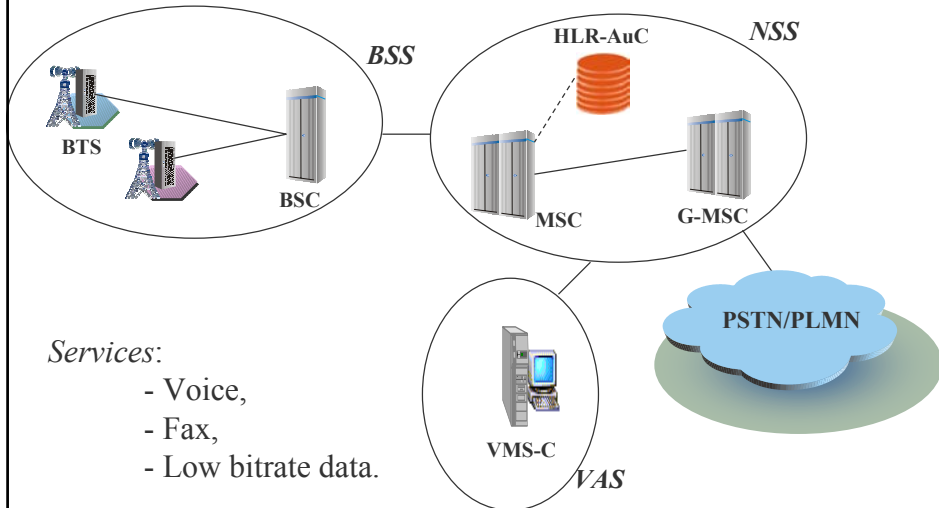# I. 2G mobile services evolution

First generation mobile systems

BTS

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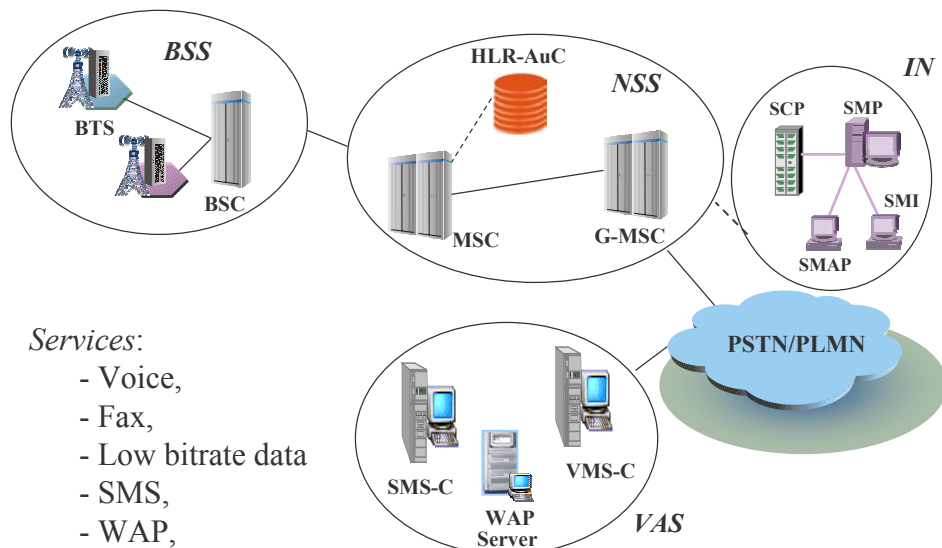
Subscribers
database

Switching +
radio control

VMS-C

PSTN

Services:
- Voice,
- Fax.

Early 2G cellular networks

BSS

NSS

HLR-AuC

BTS

BSC

MSC

G-MSC

PSTN/PLMN

VMS-C

VAS

Services:
- Voice,
- Fax,
- Low bitrate data.

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Mature 2G cellular networks (2000)

BSS

HLR-AuC

NSS

IN

BTS

BSC

MSC

G-MSC

SCP

SMP

SMI

SMAP

PSTN/PLMN

SMS-C

VMS-C

WAP Server

VAS

Services:
- Voice,
- Fax,
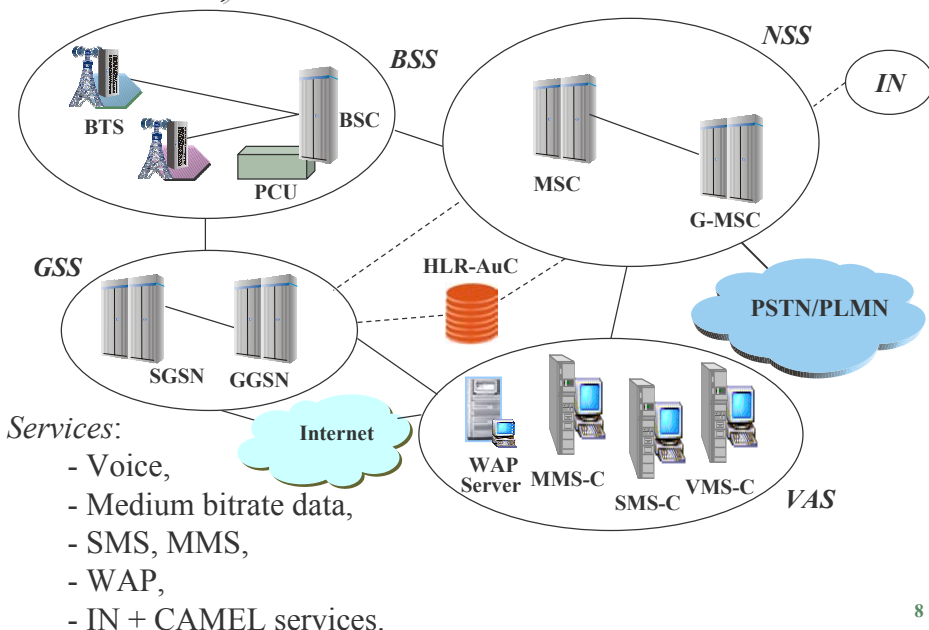- Low bitrate data
- SMS,
- WAP,
- IN + CAMEL services.

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IN services

- Business Net (VPN)
- Location Based VPN
- Mobile Business Voice
- Originating Call Routing
- Time Dependent Call Forwarding
- Call Screening
- Call Home Only
- Terminating Hunting (Reach Me)
- Sponsored Calls
- Rewards Programs
- Home Area Discount
- Cost control service
- Originating Prepaid
- Group Prepaid (Family)
- Call Me Free
- Premium Rate

- Time Based VPN
- Friends & Family
- Roaming VPN (CAMEL)
- Originating Location Routing
- Location Dependent Forwarding
- Premium Rate Barring
- Hunting Group Service
- Attendant Service
- Orig. Call Announcement
- Loyalty Programs
- Office Area Discount
- Business/Private Line
- Terminating Prepaid
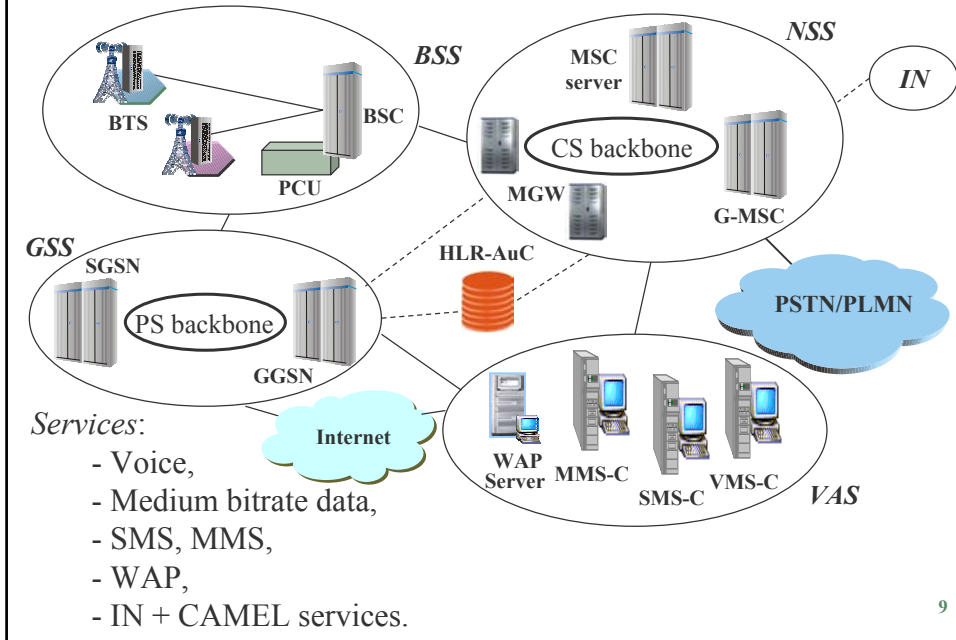- Roaming Prepaid (CAMEL)
- Freephone
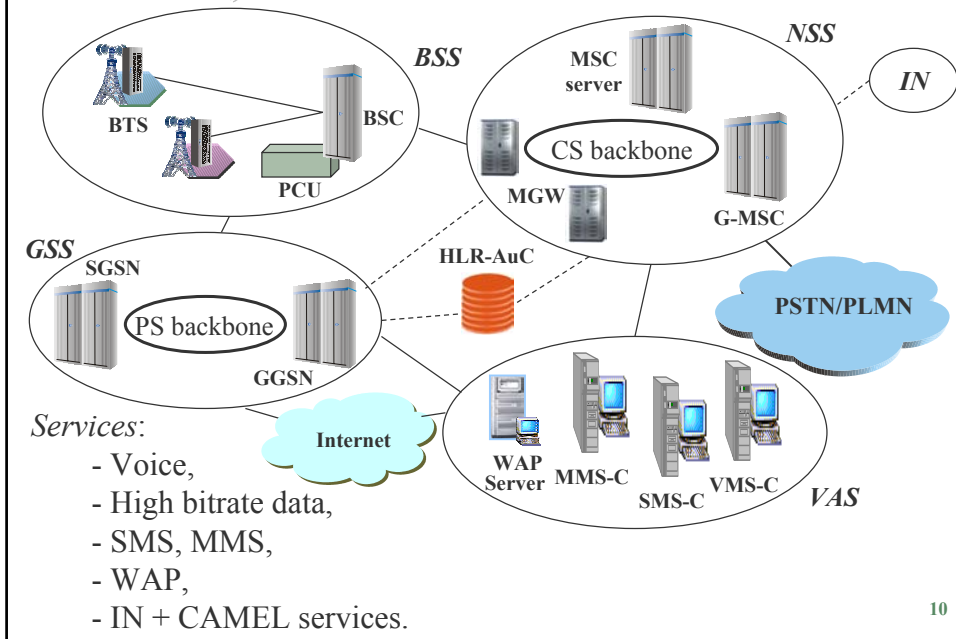
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2,5G cellular networks

Services:
- Voice,
- Medium bitrate data,
- SMS, MMS,
- WAP,
- IN + CAMEL services.

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2,5G cellular networks

BSS

NSS

BTS

BSC

PCU

MSC server

CS backbone

MGW

G-MSC

IN

GSS

SGSN

PS backbone

GGSN

HLR-AuC

PSTN/PLMN

Internet

WAP Server

MMS-C

SMS-C

VMS-C

VAS

Services:
- Voice,
- Medium bitrate data,
- SMS, MMS,
- WAP,
- IN + CAMEL services.

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2,75G cellular networks

BSS

NSS

BTS

BSC

PCU

MSC server

CS backbone

MGW

G-MSC

IN

GSS

SGSN

PS backbone

GGSN

HLR-AuC

PSTN/PLMN

Internet

WAP Server

MMS-C

SMS-C

VMS-C

VAS

Services:
- Voice,
- High bitrate data,
- SMS, MMS,
- WAP,
- IN + CAMEL services.

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Example of GSM/GPRS/EDGE services

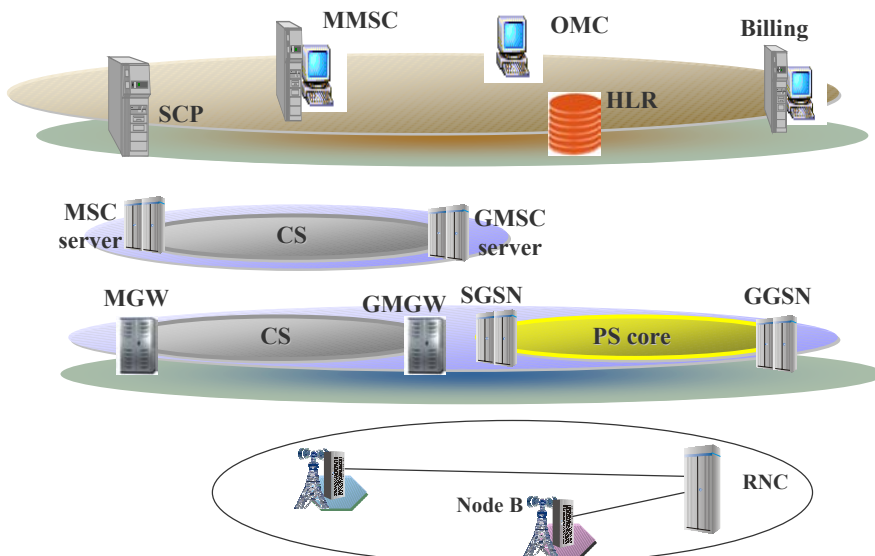| Release	Expected bitrates	Most important features and services
R99	100 kb/s	Web browsing, FTP (100 to 300 ko files), GSM/3G interface, MMS
R4 & 5	200 kb/s	WideBand AMR, Real time QoS for packet services, VoIP
R6	400 kb/s	IMS, End to end QoS, Minimum 3G services, Visiophony (?)

II. UMTS releases example

UMTS Release 99

MMSC OMC Billing

SCP HLR

MSC GMSC SGSN GGSN

CS core PS core

Node B RNC
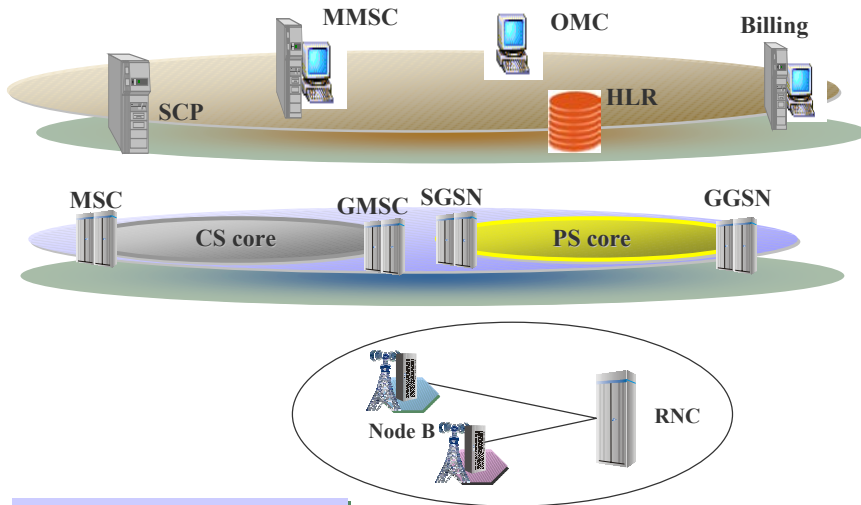
Based on GSM and GPRS

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UMTS Release 4

MMSC OMC Billing

SCP HLR

MSC server GMSC server

CS

MGW GMGW SGSN GGSN

CS PS core

Node B RNC

Control and bearer plans separation for CS

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UMTS Release 5

MMSC **OMC** **Billing**

SCP **HLR**

MSC server **CS** **GMSC server** **CSCF** **IMS** **MGCF**

MGW **CS** **GMGW** **SGSN** **PS core** **GGSN**

Node B **RNC**
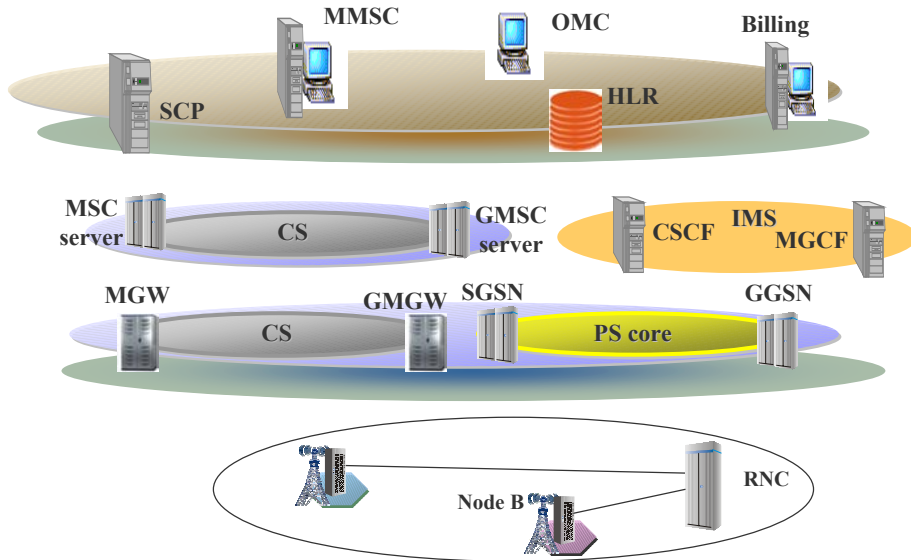
Introduction of IMS, IP in RAN

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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
Conversational	Voice, video	Real time
Streaming	File transfer (video sequence downloading)	Synchronism between entities
Interactive	Sessions (Web, databases access, …)	Low BER
Background	SMS, e-mail, FTP	Low BER and low delay constraints

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

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).
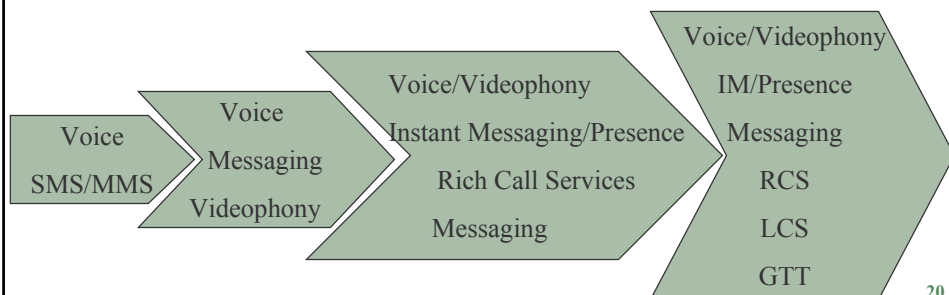
Release 6 features

- 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

Release	Services
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

Voice
SMS/MMS

Voice
Messaging
Videophony

Voice/Videophony
Instant Messaging/Presence
Rich Call Services
Messaging

Voice/Videophony
IM/Presence
Messaging
RCS
LCS
GTT

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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*

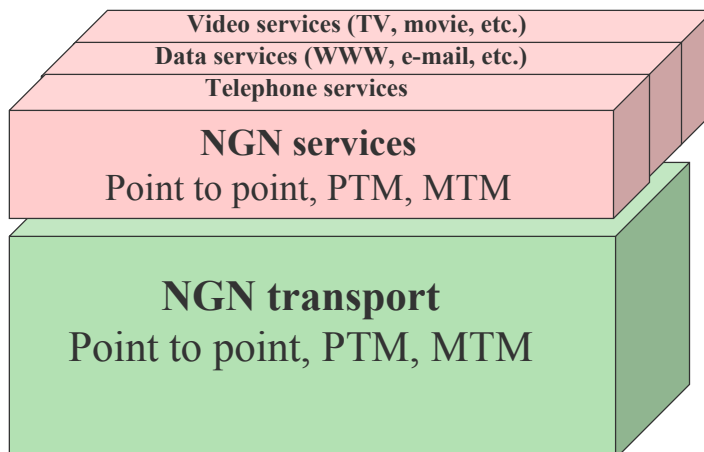with Control & Transport Layers being shared by:

- 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

Video services (TV, movie, etc.)

Data services (WWW, e-mail, etc.)

Telephone services

NGN services
Point to point, PTM, MTM

NGN transport
Point to point, PTM, MTM

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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)
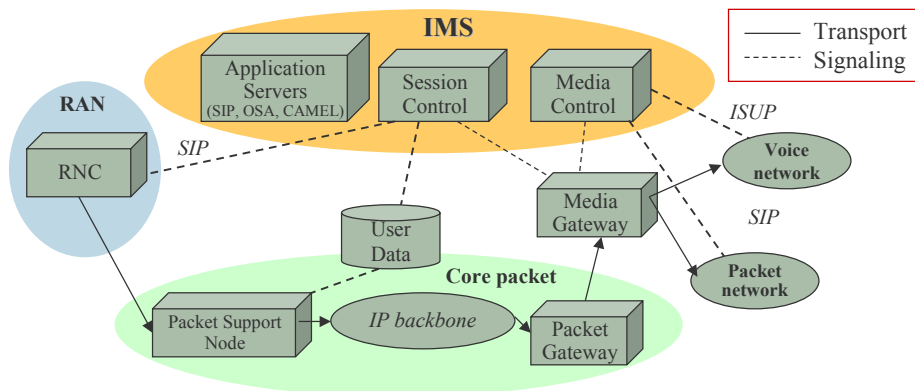- **Independancy** from access network

R5

IMS for mobile networks

Packet GPRS, EDGE, UMTS & CDMA2000
Non real time services
Plate-forme 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

IMS

— Transport
----- Signaling

RAN

RNC

SIP

Application Servers (SIP, OSA, CAMEL)

Session Control

Media Control

ISUP

Voice network

Media Gateway

SIP

User Data

Core packet

Packet network

Packet Support Node

IP backbone

Packet Gateway

S-CSCF (*Call Status Control Function*): central IMS componant;
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 différentiation 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 componants such as video, audio, whiteboard on-line sharing.
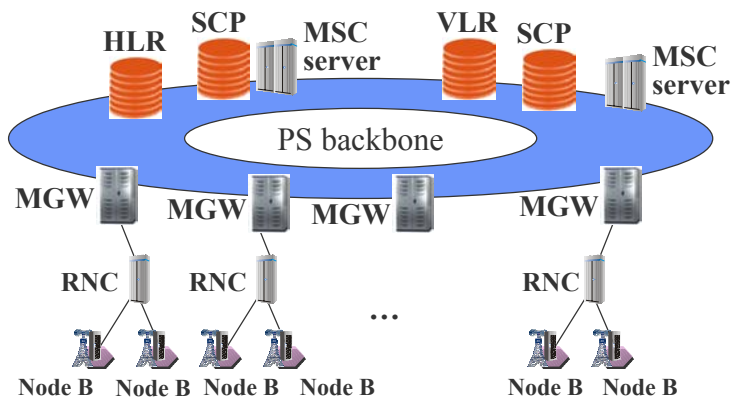
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IMS R6 enhancements

- *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).

Transition to NGN (1)

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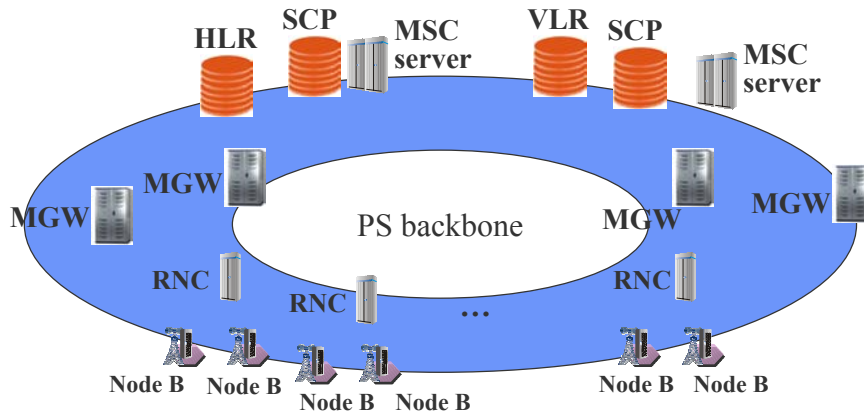- Common signaling (signaling over IP, SIGTRAN),

Transition to NGN (2)

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

HLR　SCP　MSC server　VLR　SCP　MSC server

MGW　MGW　PS backbone　MGW　MGW

RNC　RNC　...　RNC

Node B　Node B　Node B　Node B　Node B　Node B

Concluding remarks

- Evolution of networks: towards stronger separation of service/control/transport
- Fixed-mobile convergence based on NGN.
- IMS in UMTS R5: integrated to NGN (one of its components).
- Implementation, deployment and operation?