**EuroView 2007 Workshop**
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Next Generation Mobile Network
? What's different and who needs it ?

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Our Vision: 2015 – the World connected

Würzburg / Kohrt / July 24th, 2007

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NGMN MEMBERSHIP STATUS

Approved members & sponsors

13 ■ 12 Members
17 ■ 7 Sponsors
3 ■ 1 Advisor

Current NGMN Members
Current NGMN Sponsors
Current NGMN Advisor

NGMN Members

NGMN Sponsors

NGMN Advisors

as of July 20th, 2007

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Priorities

- Spectrum efficiency desired to be 6 - 8 times HSPA and EVDO
- "Mobile broadband" user experience:
  - latency < 30ms e2e
    the *radio system* should not limit the user experience

  - Increased throughput across the coverage area: e.g., peak data rates > 50 Mbps & average rates > 10 Mbps

  - 'Always On' without significant network overhead or reduction of terminal battery life

- Efficient multicast and broadcast support & delivery of conversational services (e.g. speech, video call) over an all PS infrastructure
- All achieved at a cost/performance ratio comparable to xDSL

Performance Evolution
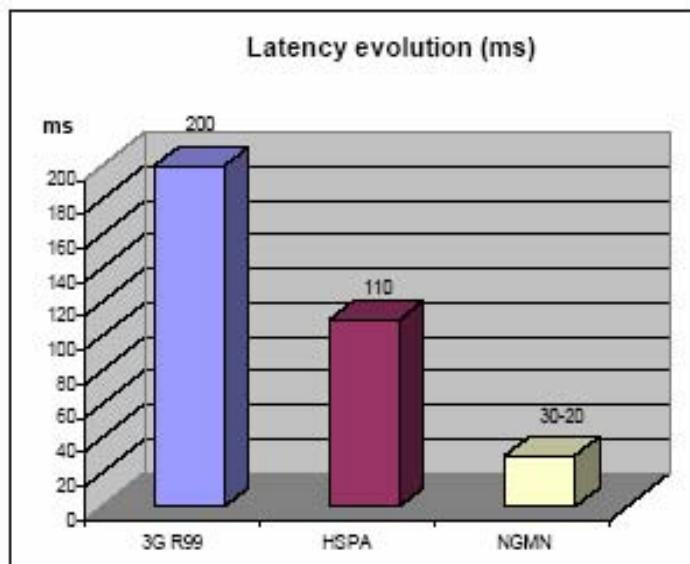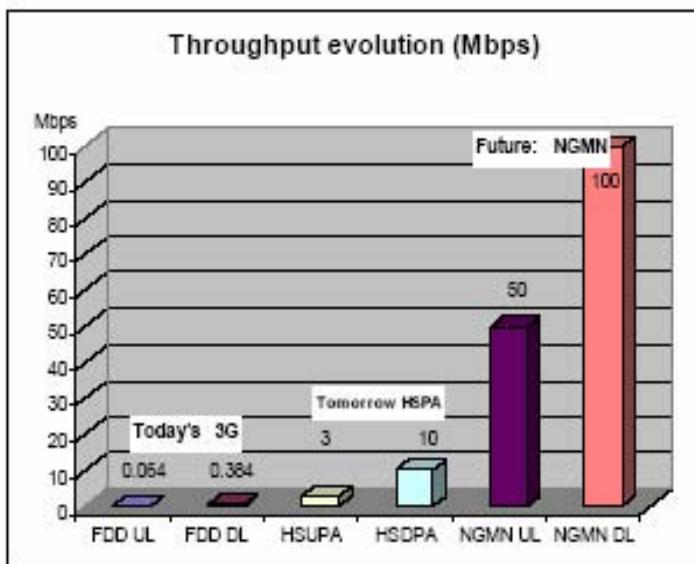
- **NGMN is meant to be a big step in terms of performance**

Technology Convergence

Broadband Mobile Communication

Rev. C / UMB

WiMAX

F-OFDM

TD-CDMA

WCDMA / UMTS / HSPA

CDMA / EVDO / Rev B

GSM /GPRS /EDGE

Next Generation Mobile Network
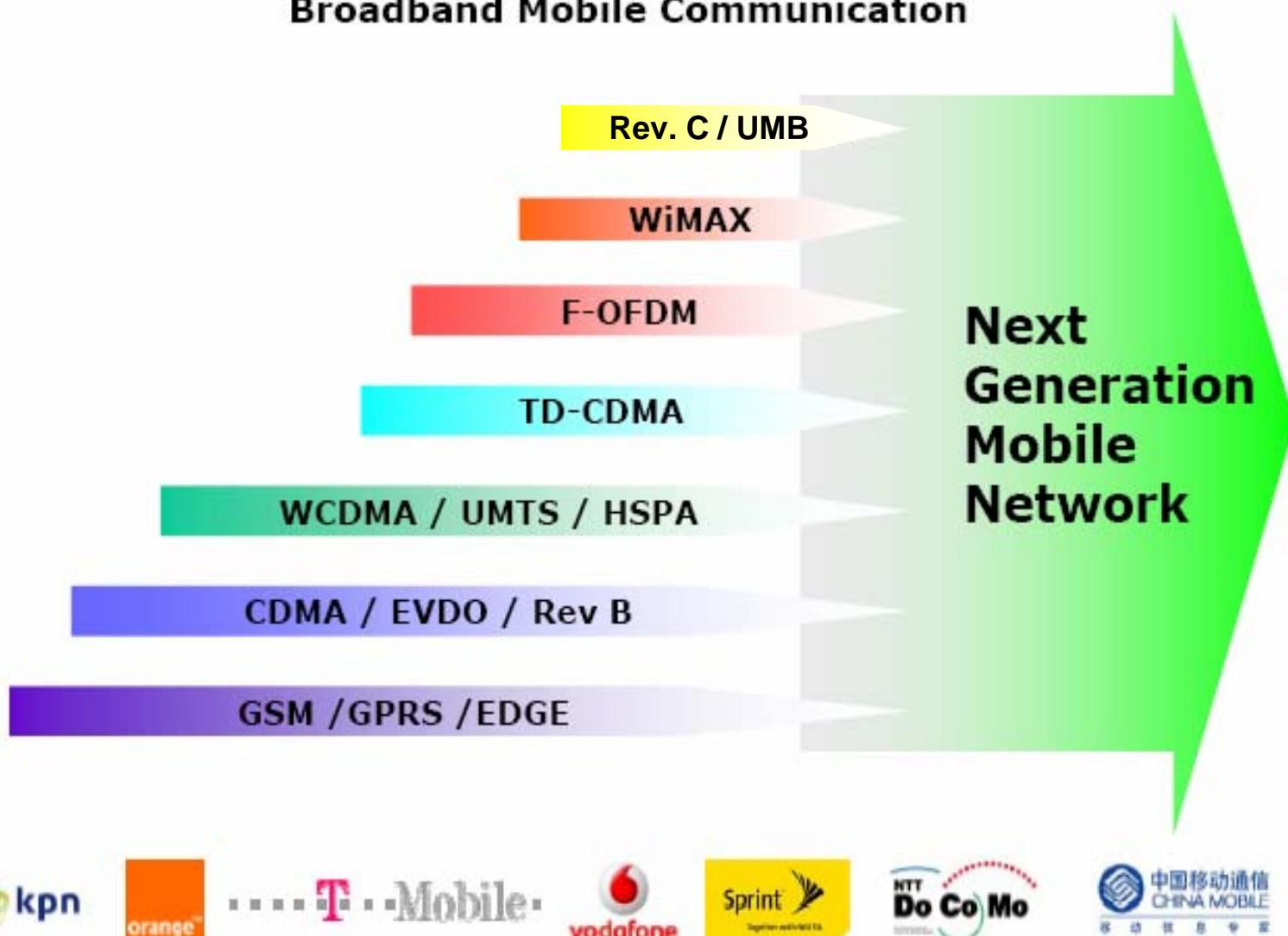
Expanding radio portfolio to address market needs

GSM/GPRS, EDGE   EDGE Evolution

WCDMA   TD-SCDMA

HSPA   **HSPA+**
I-HSPA (pre-LTE)

LTE

WiMAX-802.16e (Mobile)

WiMAX-802.16d (Fixed)

DVB-H
HSPA MBMS

2006   **2007**   **2008**   **2009**   **2010**
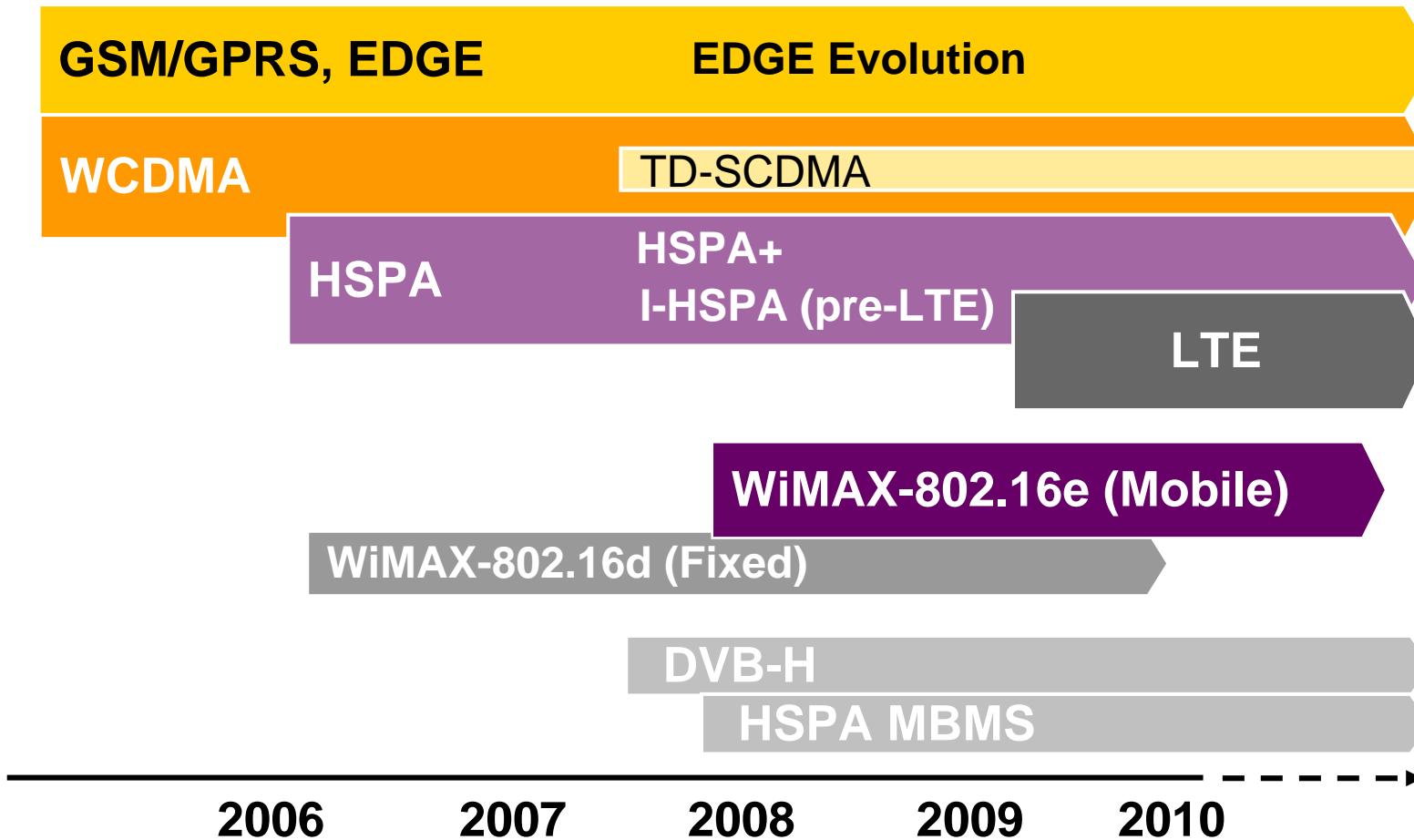
Multiradio environment
data speeds, technologies and connectivity options are multiplying

Cellular
"Seamless, trustworthy, global roaming"

LTE

I-HSPA

WiMAX

HSPA

WCDMA

cdma1x EV-DO

GPRS /EDGE

Hot Spot
"Highest data speeds over IP"

UMA

WLAN

Seamless connectivity
Complexity hidden from user

Wibree

FM radio

Blue-tooth

UWB

RFID/ NFC

MBMS

DVB-H

Broadcasting
"CNN or Sugar Bowl on the road"

Proximity
Local connectivity, info, commerce & services "

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Availability of access highways
… in terms of bit rate, coverage, quality, security

Bandwidth (bps)
[peak user data rates]

Fixed Access

Mobile Access

- 10G
- 1G
- 100M
- 10M
- 1M
- 100k

FTTH 155 Mbps

Cable 40-50 Mbps

4G 1 Gbit/s

LTE 100 Mbit/s

VDSL 50 Mbps

ADSL 3-8 Mbps

HSDPA 10 Mbps

ISDN-BRI 2x64+16 Kbps

WCDMA 2 Mbit/s

EDGE 220-384 Kbps

GSM 9,6 Kbps

GPRS 40-75 Kbps

1990   1995   2000   2005   2010   **Time**
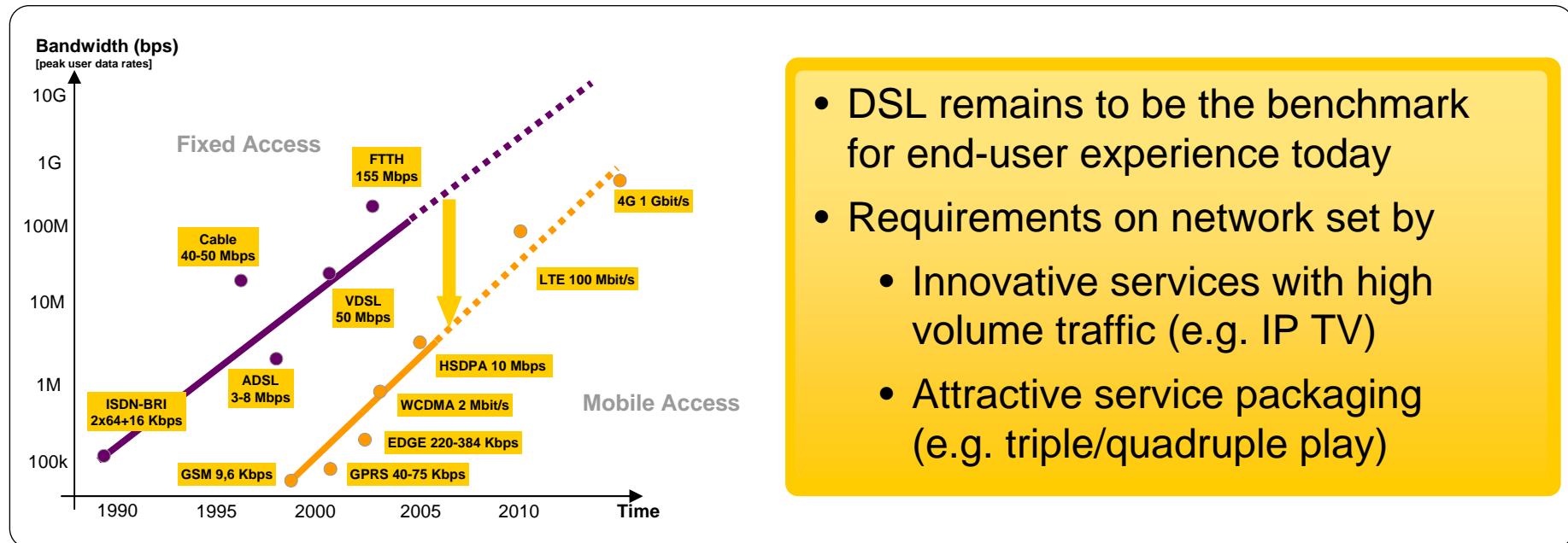
- DSL remains to be the benchmark for end-user experience today
- Requirements on network set by
  - Innovative services with high volume traffic (e.g. IP TV)
 - Attractive service packaging (e.g. triple/quadruple play)

- Increase of bitrates on copper cables utilizing the existing infrastructure
- Improvement of fiber optics to maximize performance-to-cost-ration
- Radio access evolution is addressing performance and cost challenges
- Build-up of powerful and flexible backbones for high-volume traffic at high quality

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Pressure on bit cost efficiency
… despite higher capacity

Traffic [MB], Speed [Mbps]

ARPU

ARPU per MB
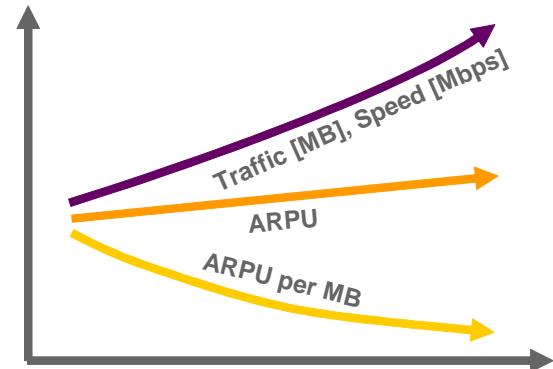
- Dramatically growing traffic based on IP connectivity
- Need to provide high bit rates / capacity at low cost
  - Limited radio resources by their nature
  - Limited bandwidth over copper
- But: moderate ARPU growth achievable only

Cost per delivered MByte

- 50%
- 50%
- 50%
- 50%

GPRS   EDGE   UMTS   HSPA   LTE
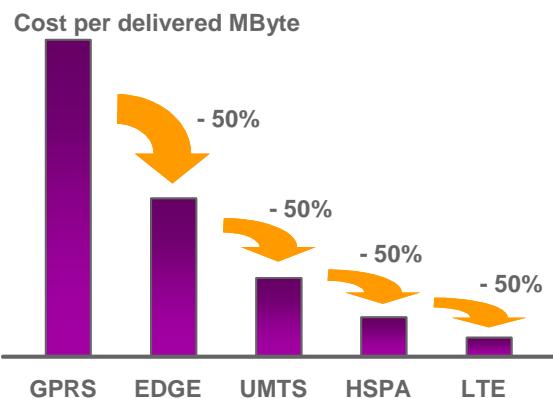
Reduce cost of delivered MB/user

- Increase network capacity
  - Use fiber optics close to the end-user
  - Increase radio spectral efficiency
- Optimize network deployment and operational cost
  - Reduce network complexity
  - Apply multiple radio access technologies
- Increasing integration level of RF-parts

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Complementarity > Co-existence > Convergence > …

IP goes mobile (IEEE)

Mobility goes IP (3GPP)

2004/5   2006/7   2008/9   2010/12

NGMN

WLAN
WIMAX 802.16d
pre WIMAX
WIMAX 802.16e

Next Generation Mobile Network

R7 Charging/QoS
R6 RAN
R5 IMS
R4 PS/CS Core

full mobility   wireless / nomadic
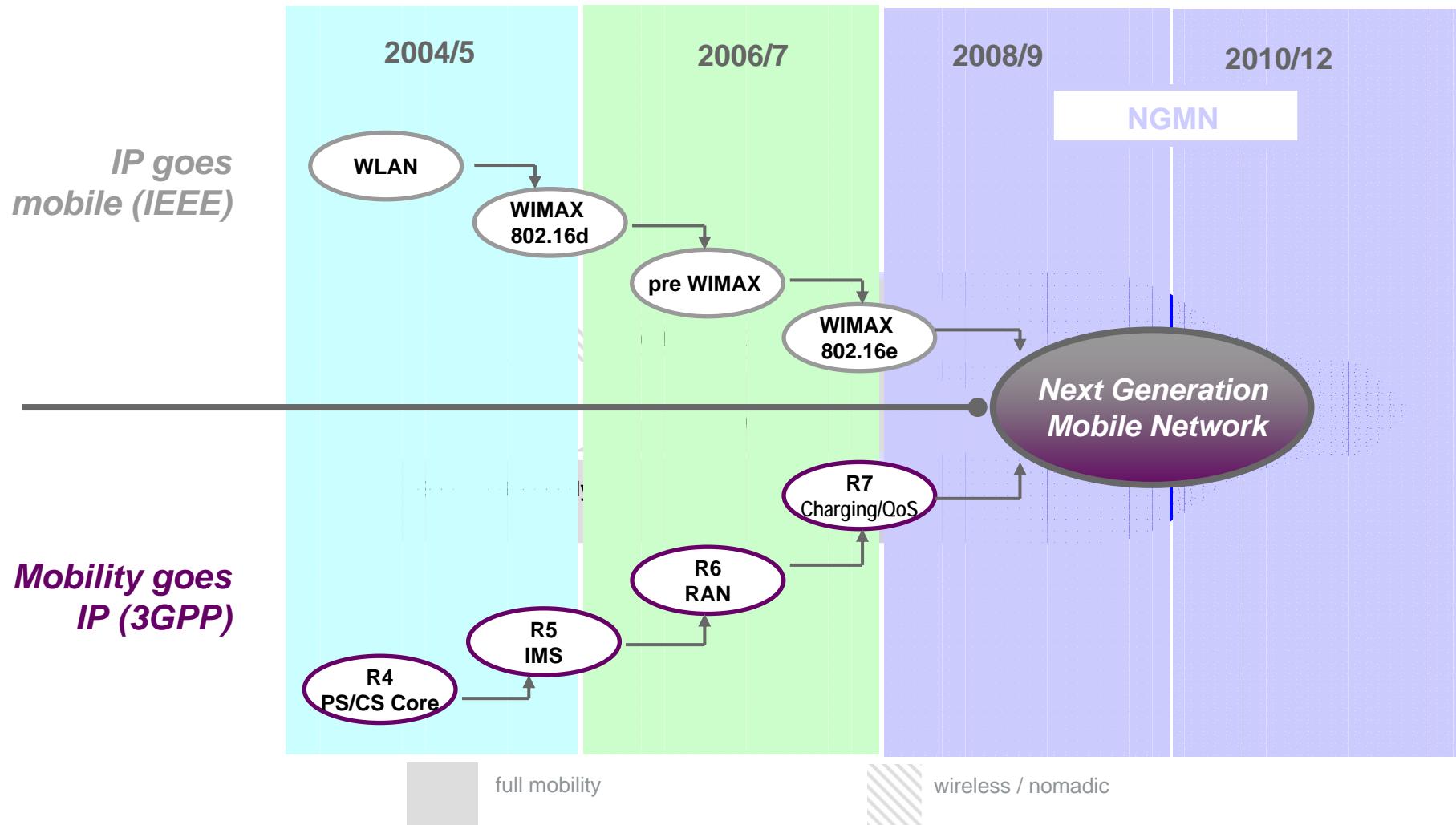
The first / last „mile" (or less) will be wireless
LTE has demonstrated >>100Mbps, IMT Advanced will do 1Gbps

Technology is ready to deliver …

	Senses	Bandwidth of Receptors	Neuronal Transmission
	Eyes	200Gbit/s	200Mbit/s
	Ears	4 Mbit/s	2 Mbit/s
	Skin	1,5Gbit/s	10 Mbit/s
	Tongue	150Mbit/s	11 Mbit/s
	Nose	20 Gbit/s	30 Mbit/s
	Σ =	ca. 200 Gbit/s	ca. 250 Mbit/s

… more than you can handle

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But, what about:

- Spectrum – sufficient & suitable ?
- Range / Coverage ?
- Backhaul – the second mile ?
- Devices – battery power ?
- …

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Network Transformation (1)

Fixed Access · **Fixed Core** · **Aggregation** — Fixed Network

Transport · **IP Core** — Data Network

Mobile CS Core · **Mobile PS Core** · **Mobile Access** — Mobile Network
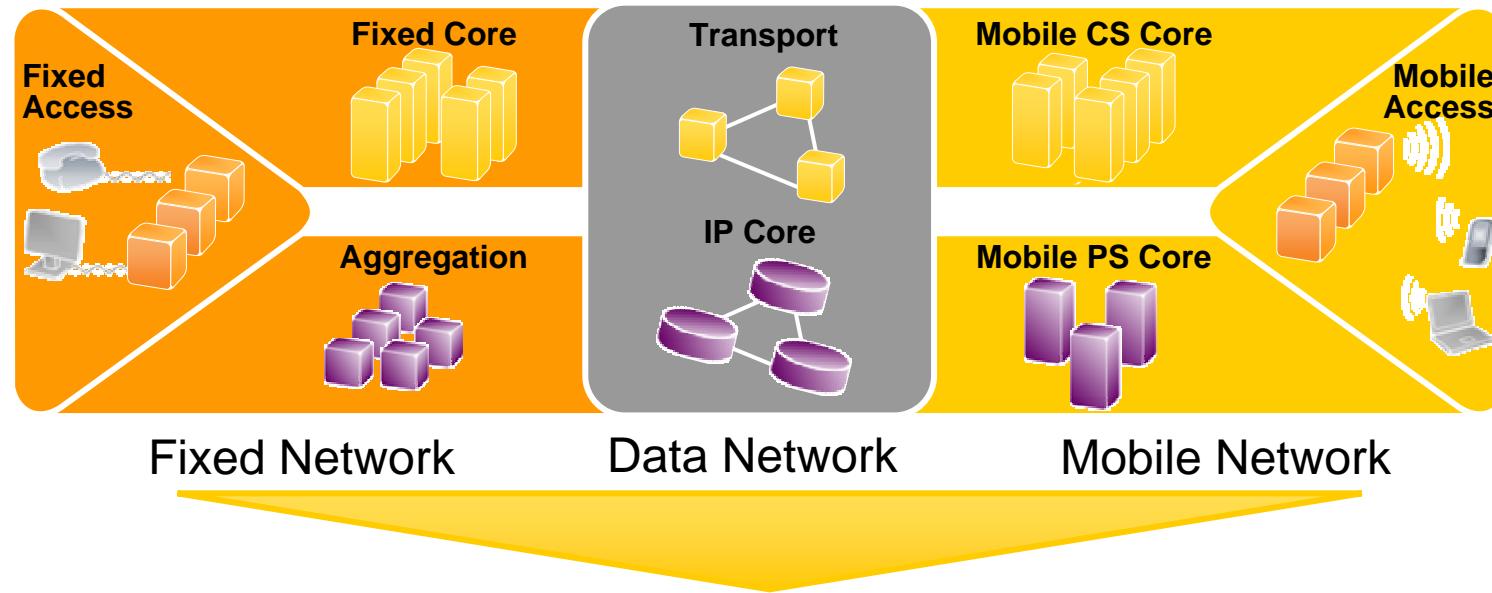
Converged Network

Operation and Business Support Systems

Multi-Access

IP Networking, Transport and Aggregation

Service Core and Applications

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Network Transformation (2)

Operation and Business Support Systems

Service Core and Applications

IP Networking, Transport and Aggregation

Multi-Access

Network Vision

Applications

Service Delivery Platform
incl. Simulation of Voice Services & IN appl.

Session Control
(IMS & MSS)

Identity Management
(HLR, HSS, AAA, ENUM, ...)

all optical IP Transport and Aggregation
based on CE, incl. Mobility Support and Service Awareness

Fixed Broadband
(DSL ⇨ PON)

Wireless Broadband
(WiFi, WiMAX)

Cellular Broadband
(UMTS, HSPA ⇨ LTE)

OSS/BSS
(Charching; Provisioning, ... whole sale support)

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The key architectural concepts (simplified) of NGMN/LTE aim at a flat and cost effective network

Access

Core

Control

UMTS/HSPA

Node B

RNC

SGSN

MGW

GGSN

MSC

IMS

HLR/HSS

Move of functionality

NGMN (3G LTE)

eNode B

MBS

MGW

aGW

IMS

HLR/HSS

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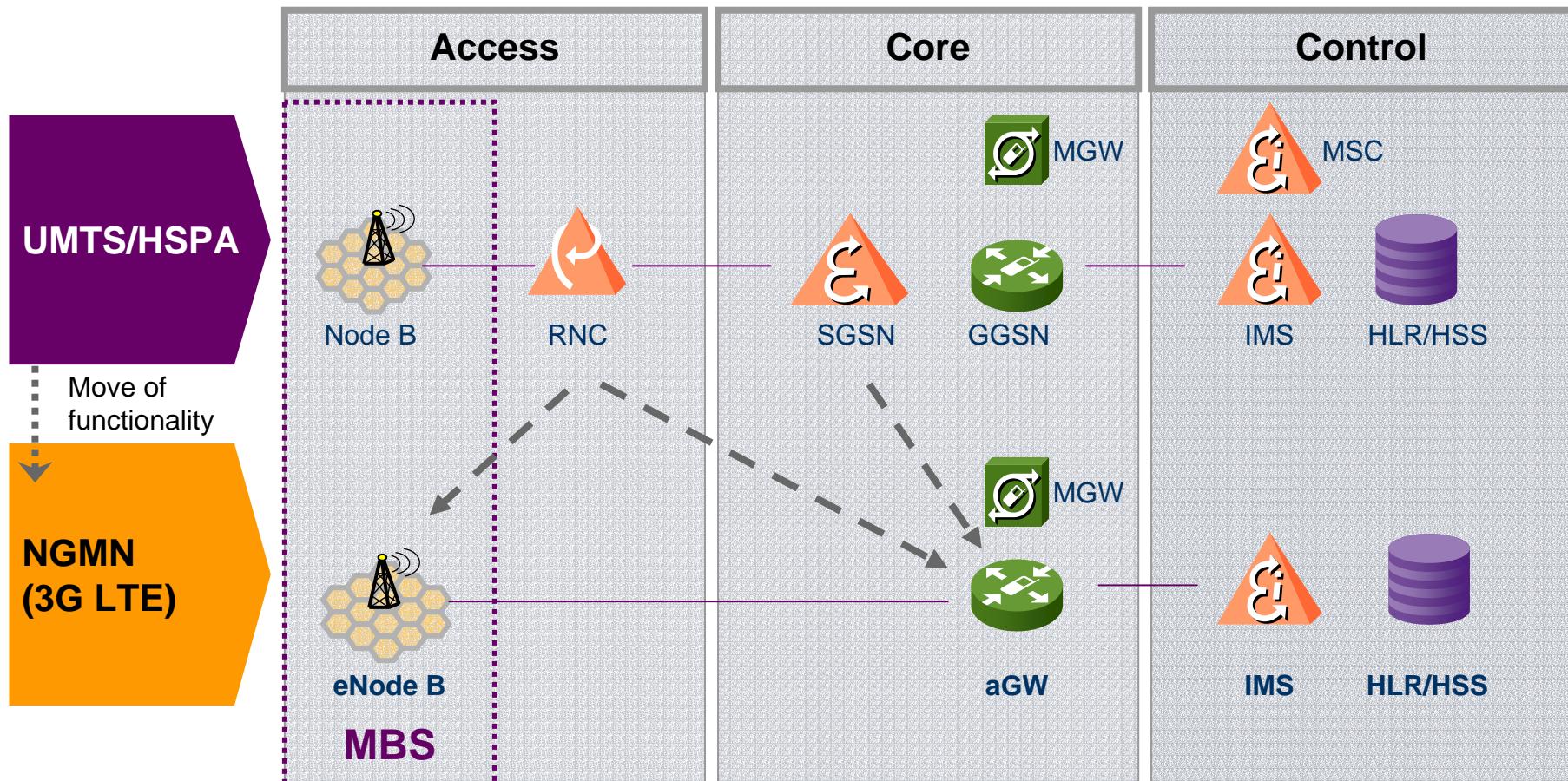
NGMN access is competitive with DSL and WiMAX by redistribution of Radio & Core functions

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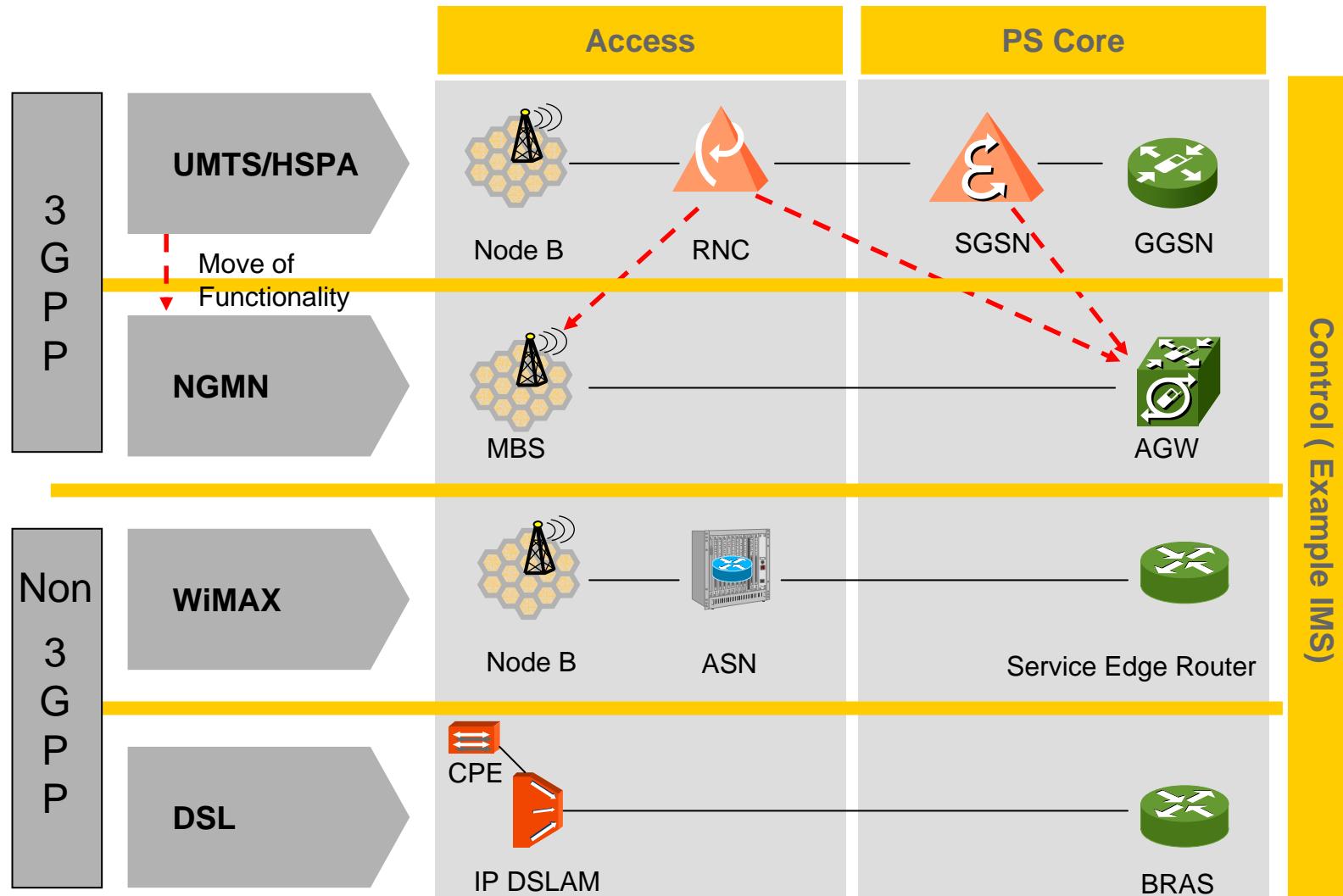
Aggregation and Transport Strategy:
IP service aware, converged flat network

PS Solution 2006-2007

BTS BSC

Iub

Node B RNC

Iub

Gb

Iu

BWA

SGSN

Gn

GGSN/IPS

PCS IMS
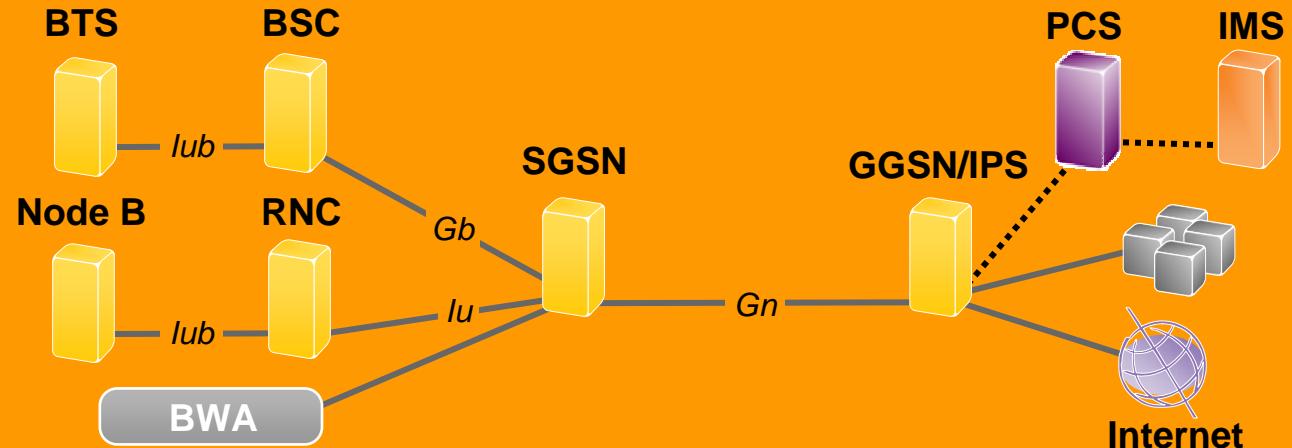
Internet

Target Solution 2010:
Support of NGMN and Legacy

2G / 3G Legacy

Iu, Gn

NGMN Radio eNode B (LTE)

S1

DSL, CATV, BWA

Eth/IP

Intelligent Service Access Node

PCS IMS

Internet

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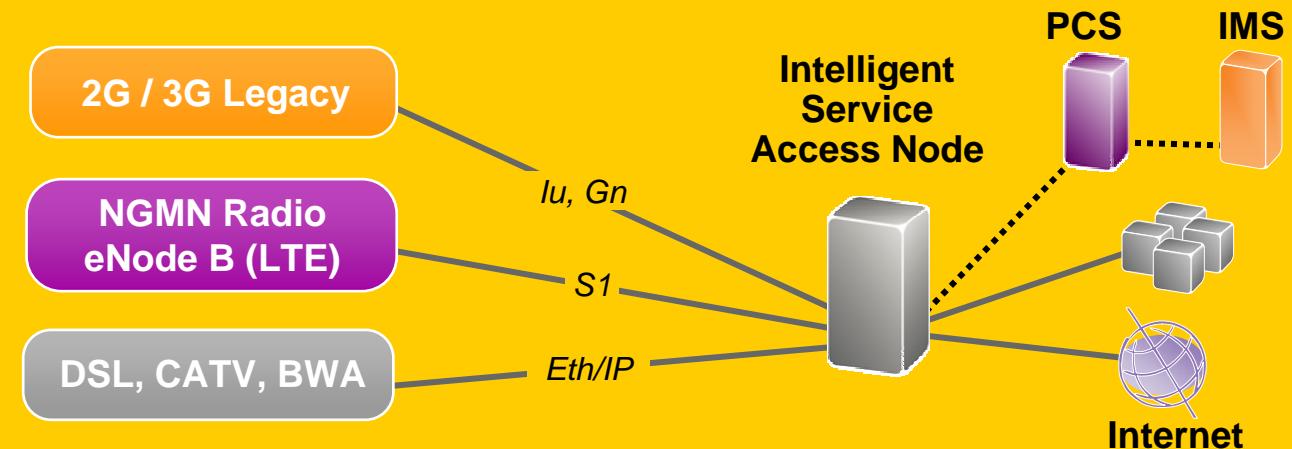
Flat Cellular Broadband Access
Evolution towards a flat Packet Core architecture (SAE)

iHSPA

| HSPA R6 | HSPA R7 | Flat HSPA R7 | LTE R8 |

HSPA R6
- GGSN
- SGSN
- RNC
- Node-B

HSPA R7
- GGSN
- SGSN
- RNC
- Node-B

Flat HSPA R7
- ISN
- SGSN
- Node-B

LTE R8
- aGW UPE
- aGW MME
- eNode-B

•••• = control plane

——— = user plane

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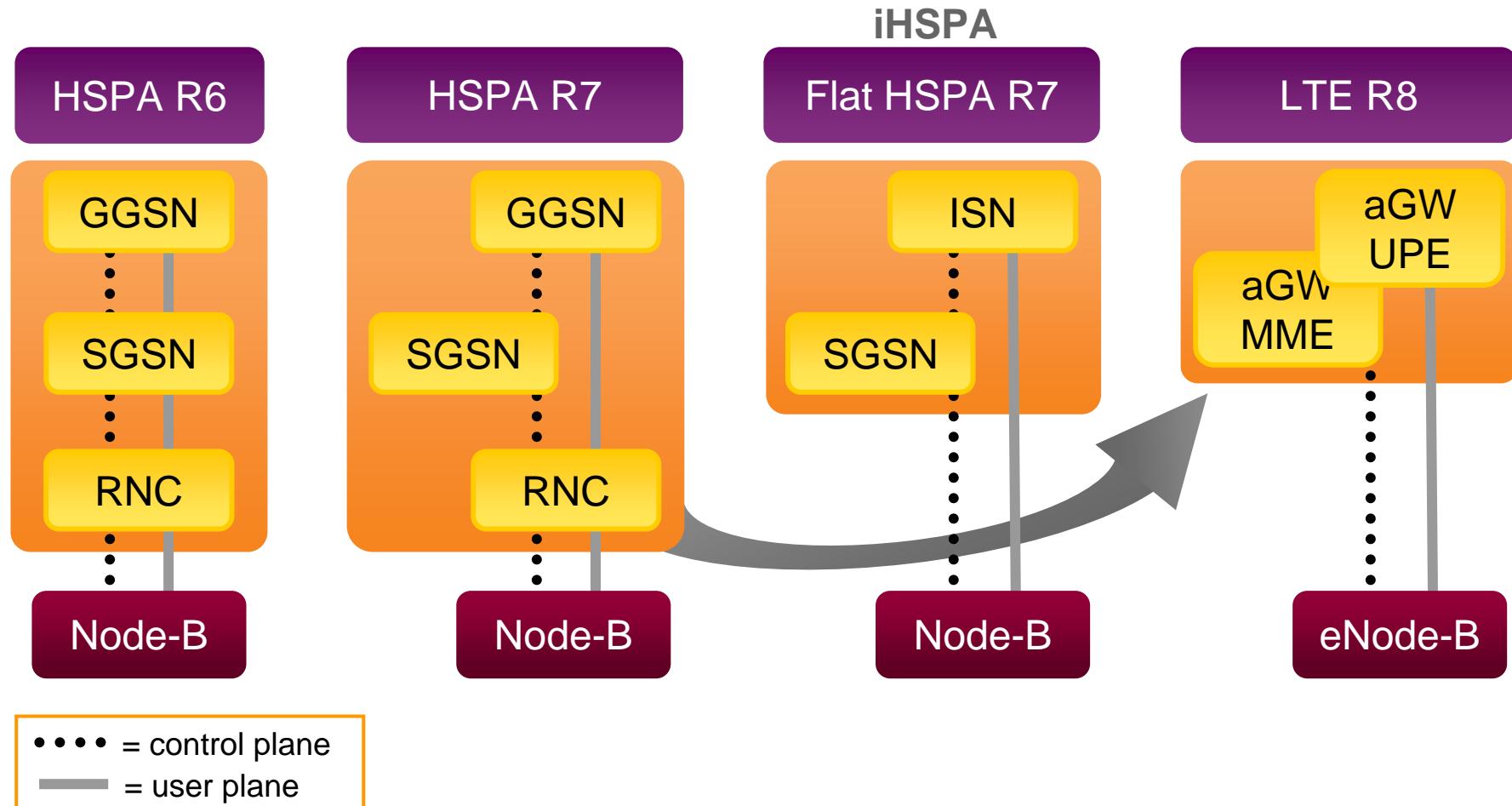
So, who is going to win the „battle of the bits"?

- Fixed Operator
- Mobile Operator
- Internet Provider
- Cable-TV Operator
- Broadcast Operator
- Broadband Access Provider
- …

… none of the above (alone) !

Ultimately, the consumer is in the driving seat

New business model: Internet at its core
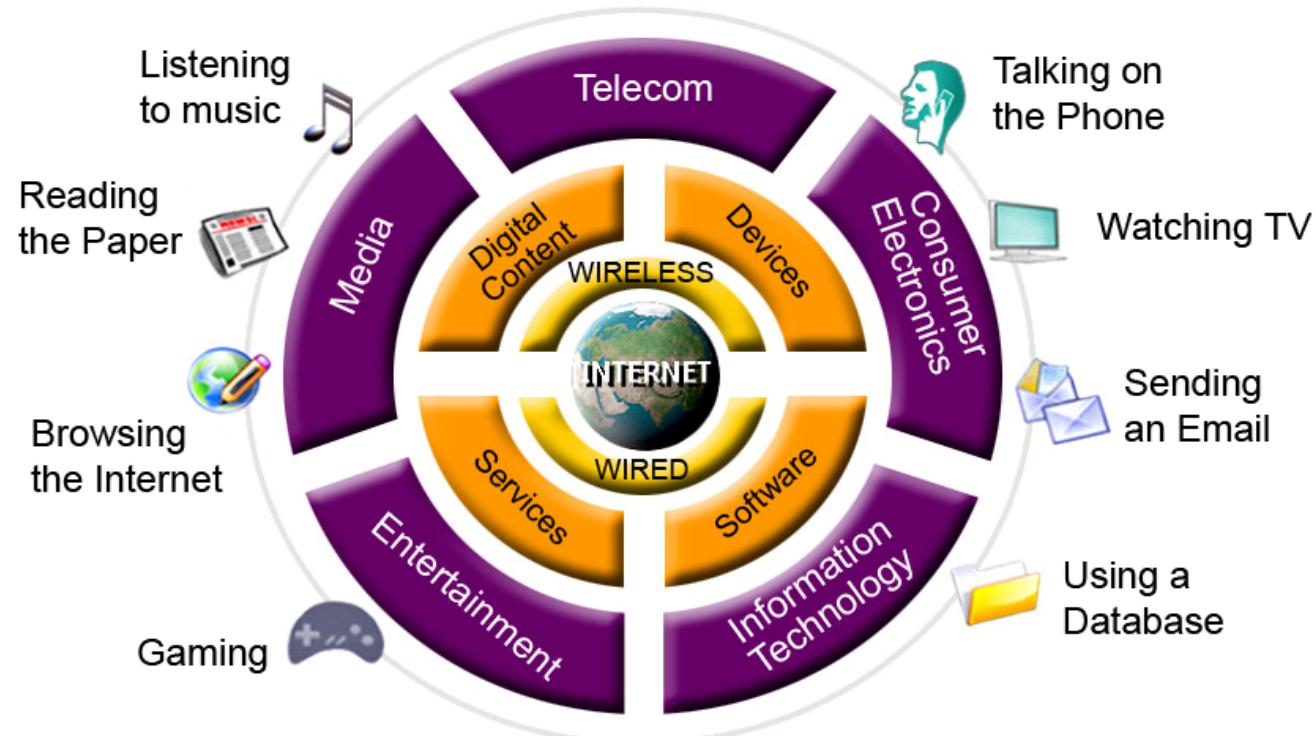
Observations

- Wireless is just another access pipe
- Mobility is access independent
- (R)AN and Core collapse to flat IP
- IMS control ensures service convergence
- Applications and content from the internet

- Inter-networking is taken for granted (!?)

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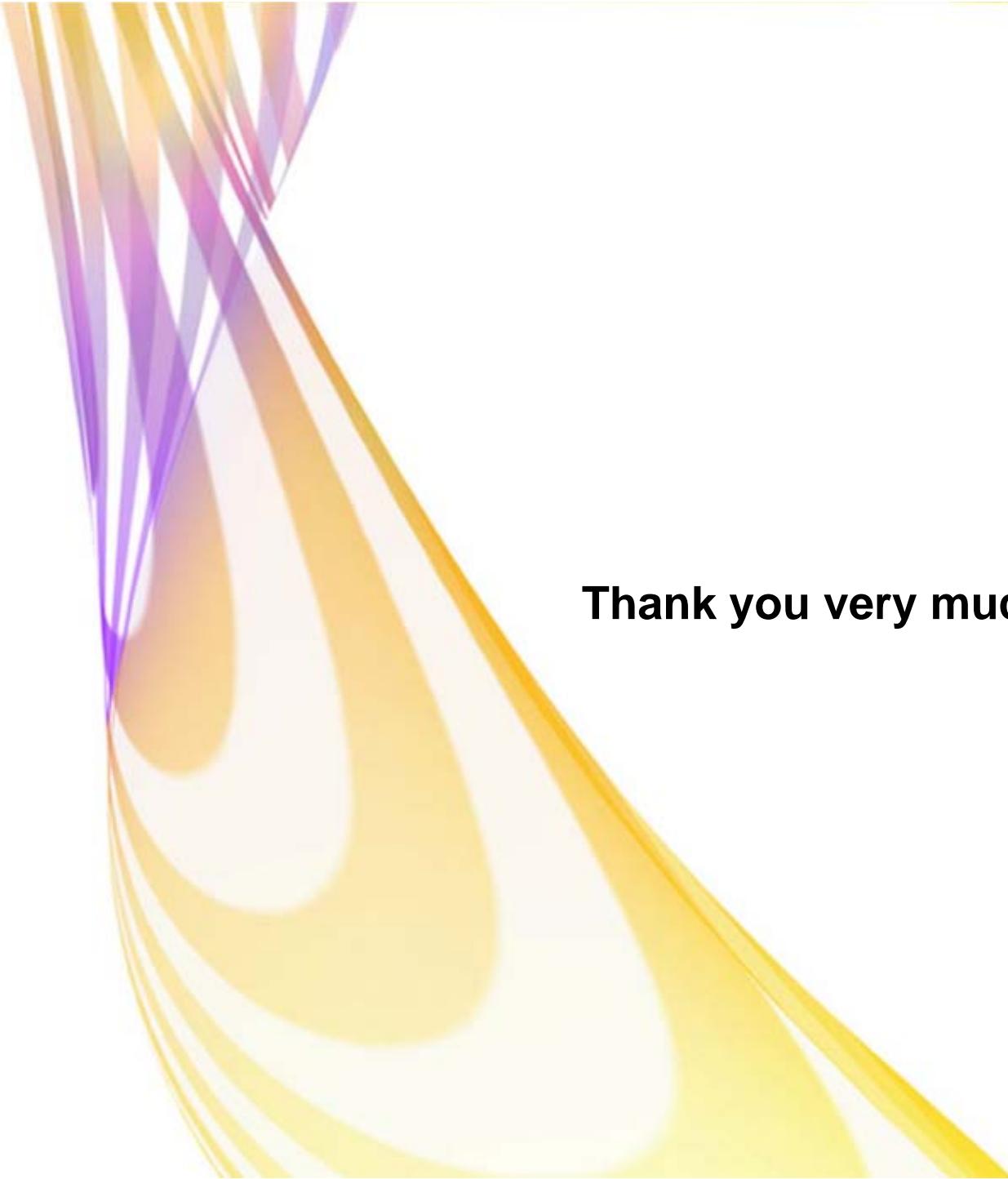
Thank you very much for your attention

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