

# Do we need Next Generation Mobile Networks ? Yes.

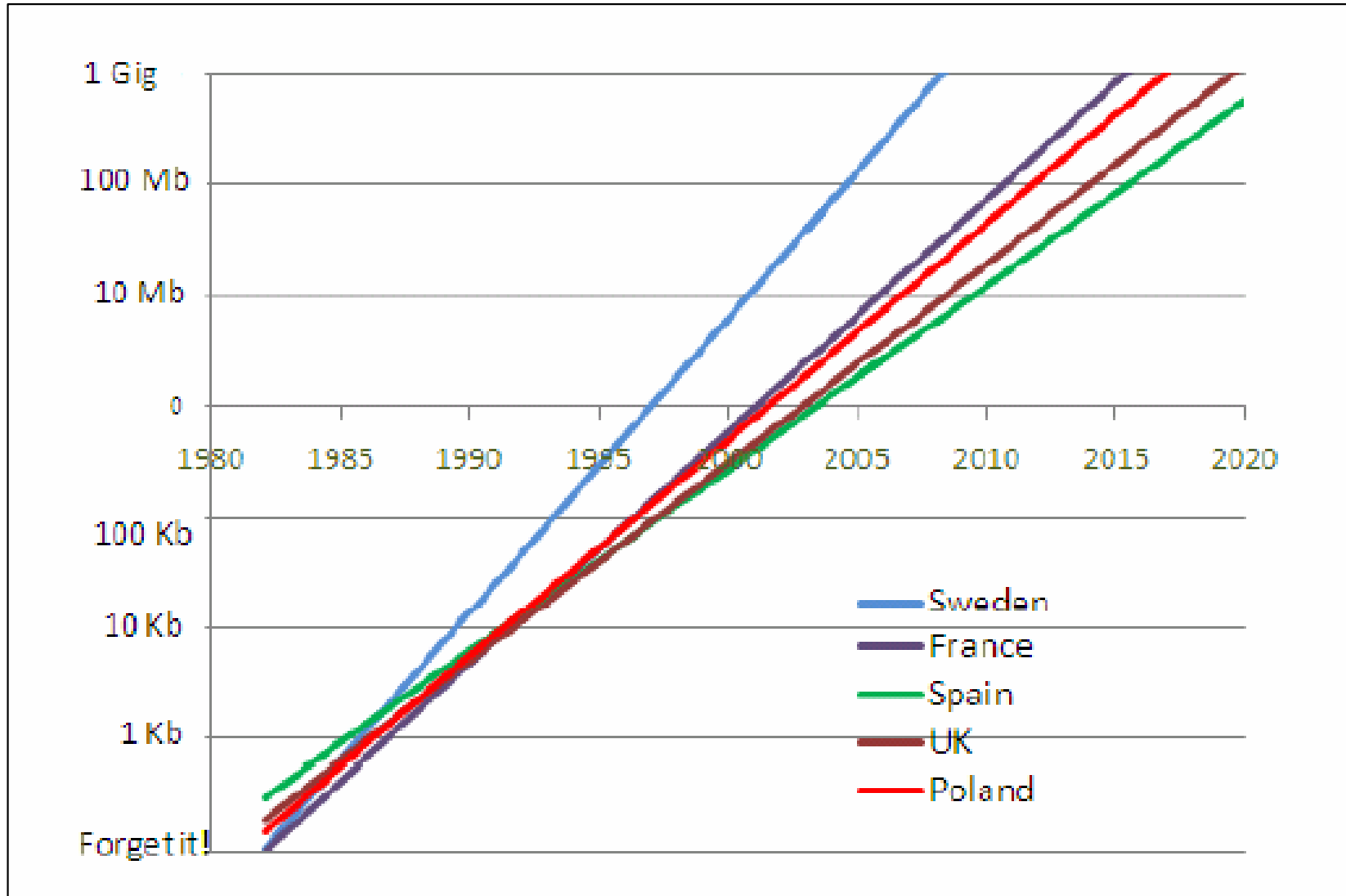
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Hungary

# Why NGMN: Bandwidth!

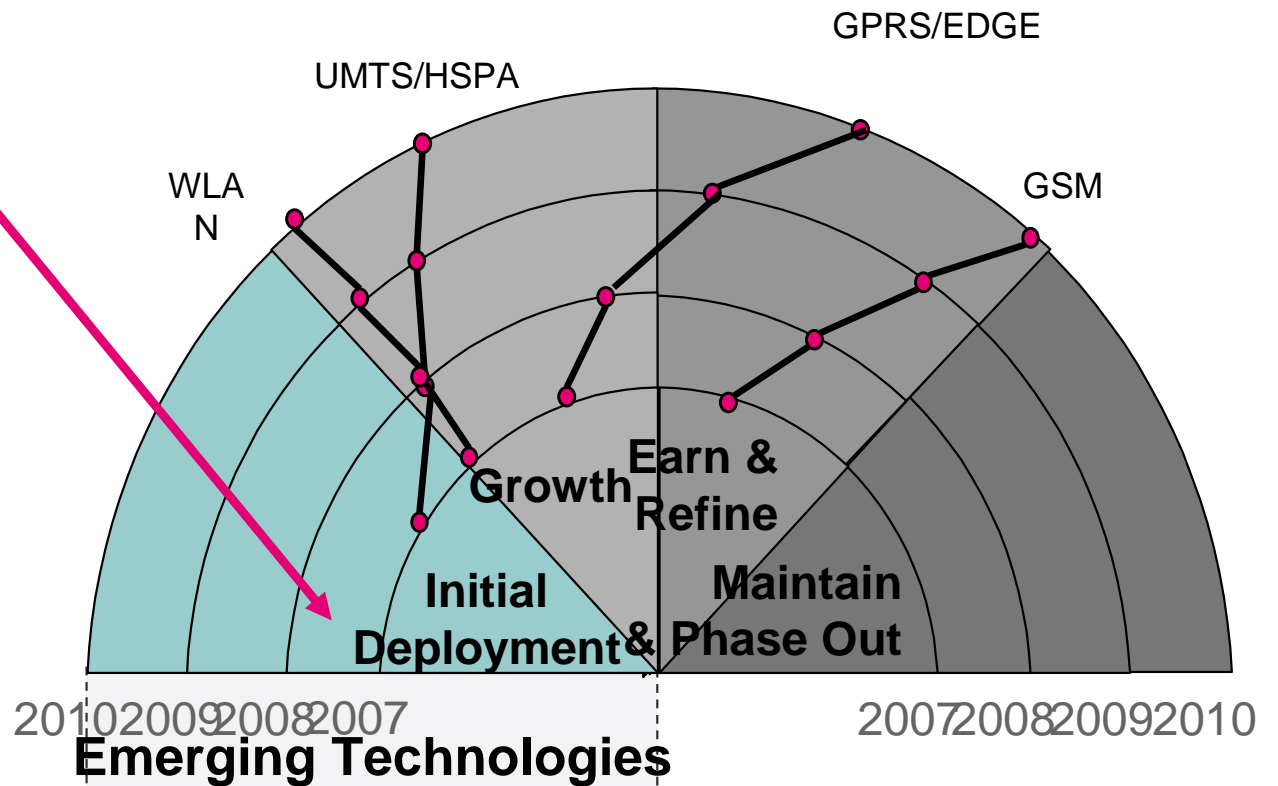
Nielsen's law: bandwidth of top internet user segment



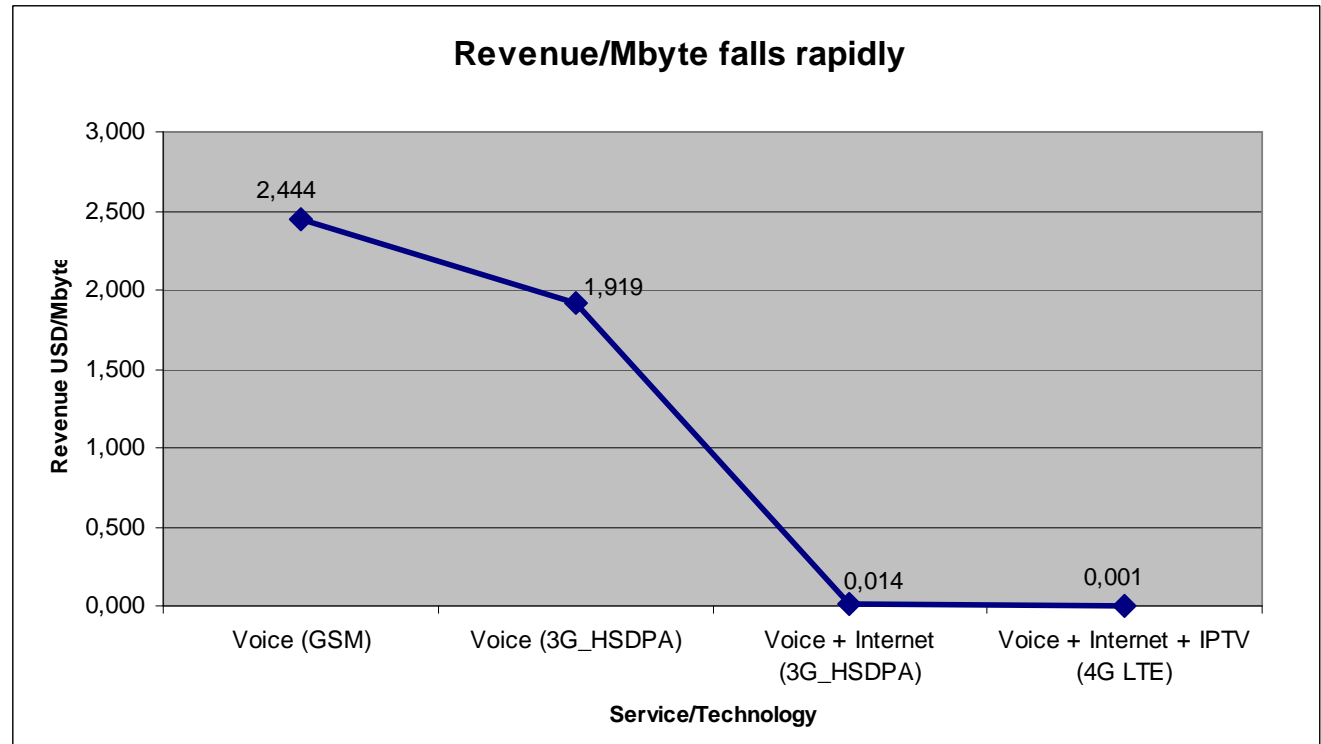
# Why NGMN?

Technology development

Radar screen is empty for the future



# Why NGMN? Capacity!



Due to dropping prices capacity expansion costs on HSPA must be pushed down.  
One way is introducing new technology:

„Internet traffic will increase 6x in the coming years” Cisco

„Mobile broadband will exceed 50% of pop penetration in the next 5 years..”

# The biggest obstacle is the cost of expansion

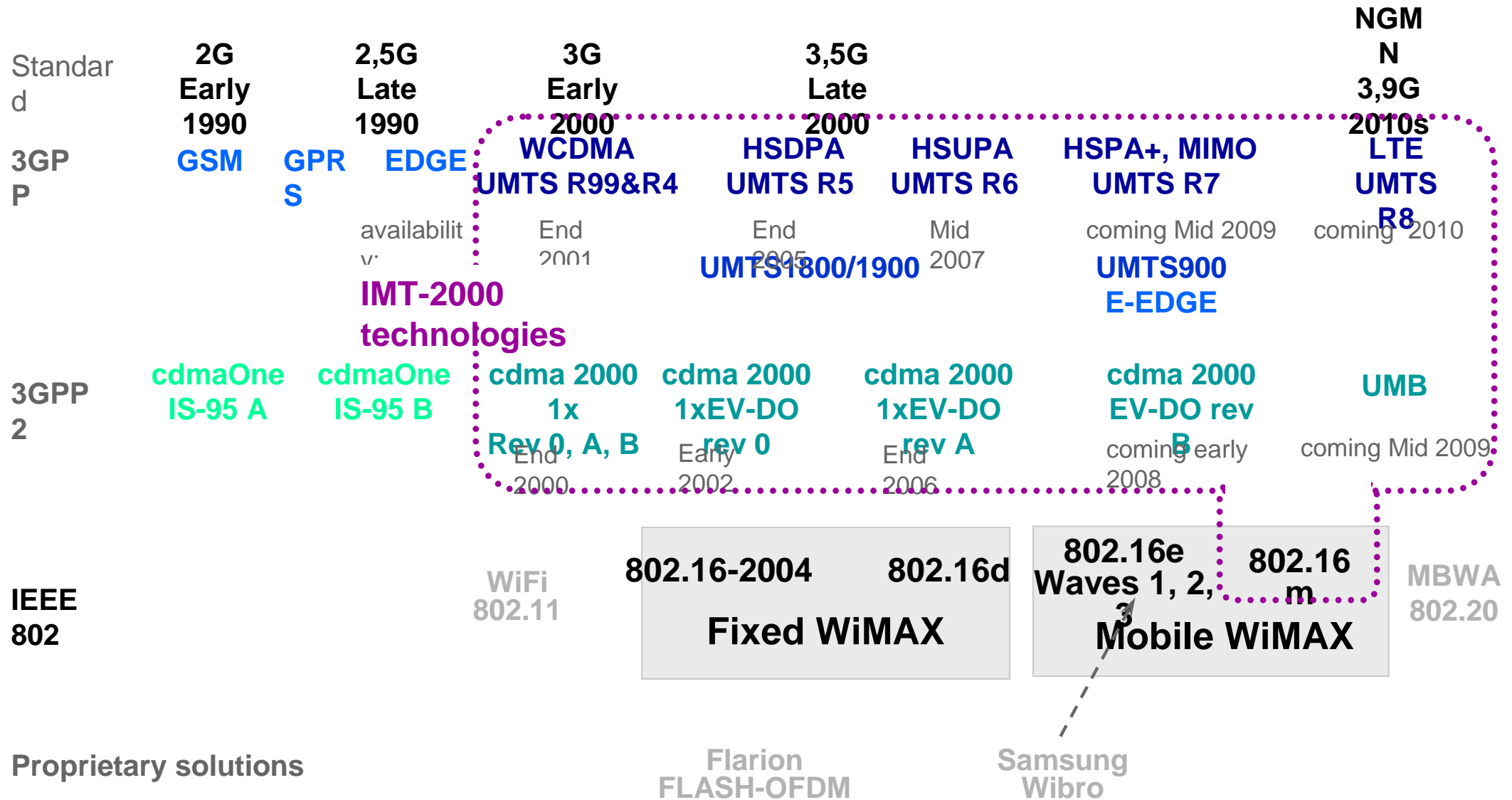
	HSDPA@1,5GB/Month	HSDPA@9,5GB/Month	LTE@9,5GB/Month
Network capex coverage	<100€	<100€	n/a
Network capex capacity+coverage	100-1000€	>>1000€!!	100-500€

# Promising or frightening forecasts

- mobile internet usage will be as common as mobile voice today,
- increased share of video streaming content,
- cost efficient technology optimized for available spectrum (asset!) and quality of service based on customer value
- 10x10 rule: 10GB/Month usage & 10Mbps/user bandwidth
- candidate technology: LTE
- alternatives: HSPA+, WLAN in hot spots, do nothing etc.  
compounded by different spectrum options

# Technology Roadmap

Positioning EVDO rev B; LTE; WiMAX



# We are in trouble

-if LTE doesn't deliver on promise =a 10x better performance than HSPA needed for breakthrough,

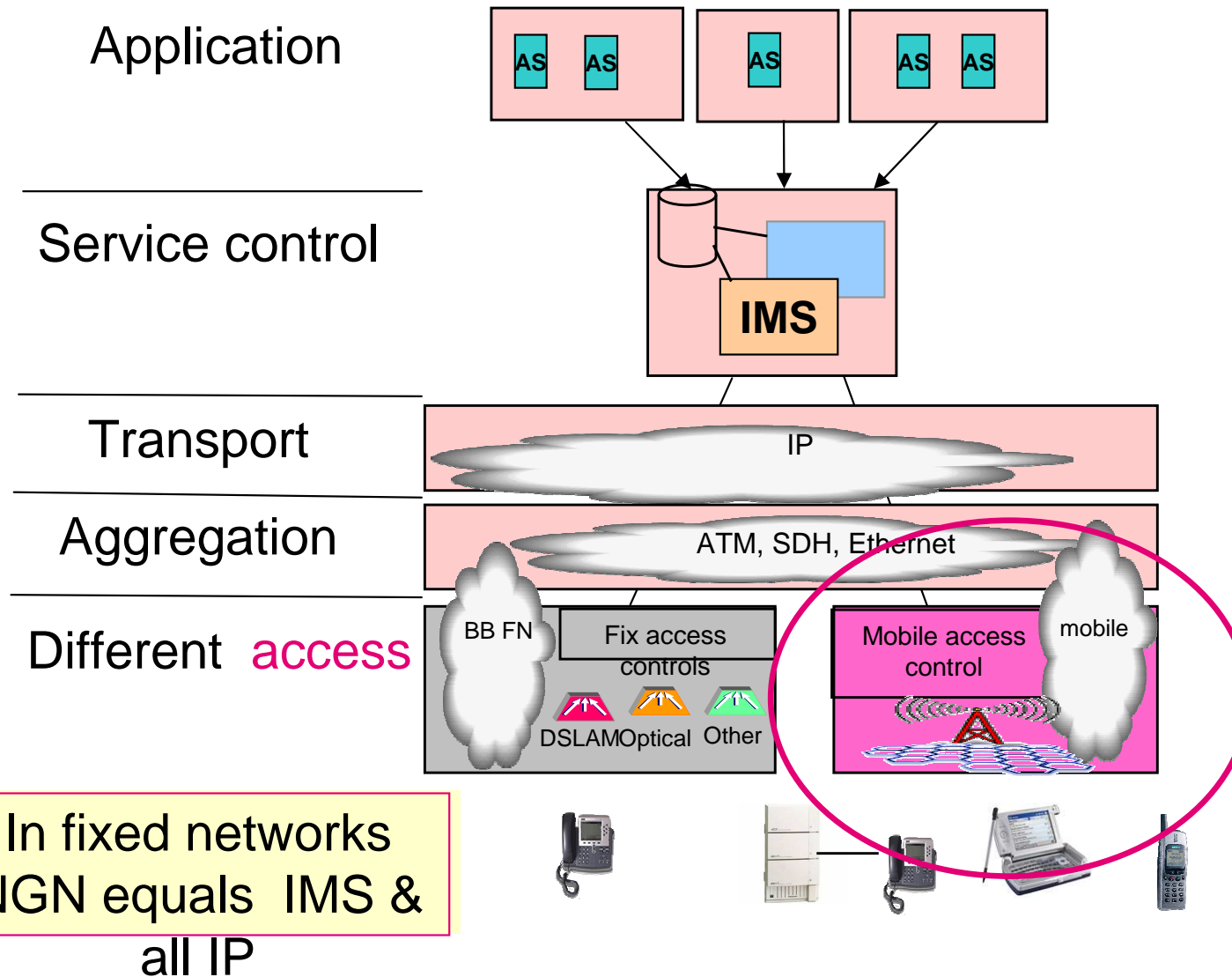
-if the delivery is delayed, the risk is substantial, that operators will continue to deploy on the HSPA road map and consider LTE in their next investment life cycle.

-if the regulators do not consider the urgency of freeing up spectrum on time (at least 20 MHz per operator to fully leverage the performance of LTE).

-maybe HSPA+ is good enough for the next 5years (traffic&bandwidth)

# What is NGMN?

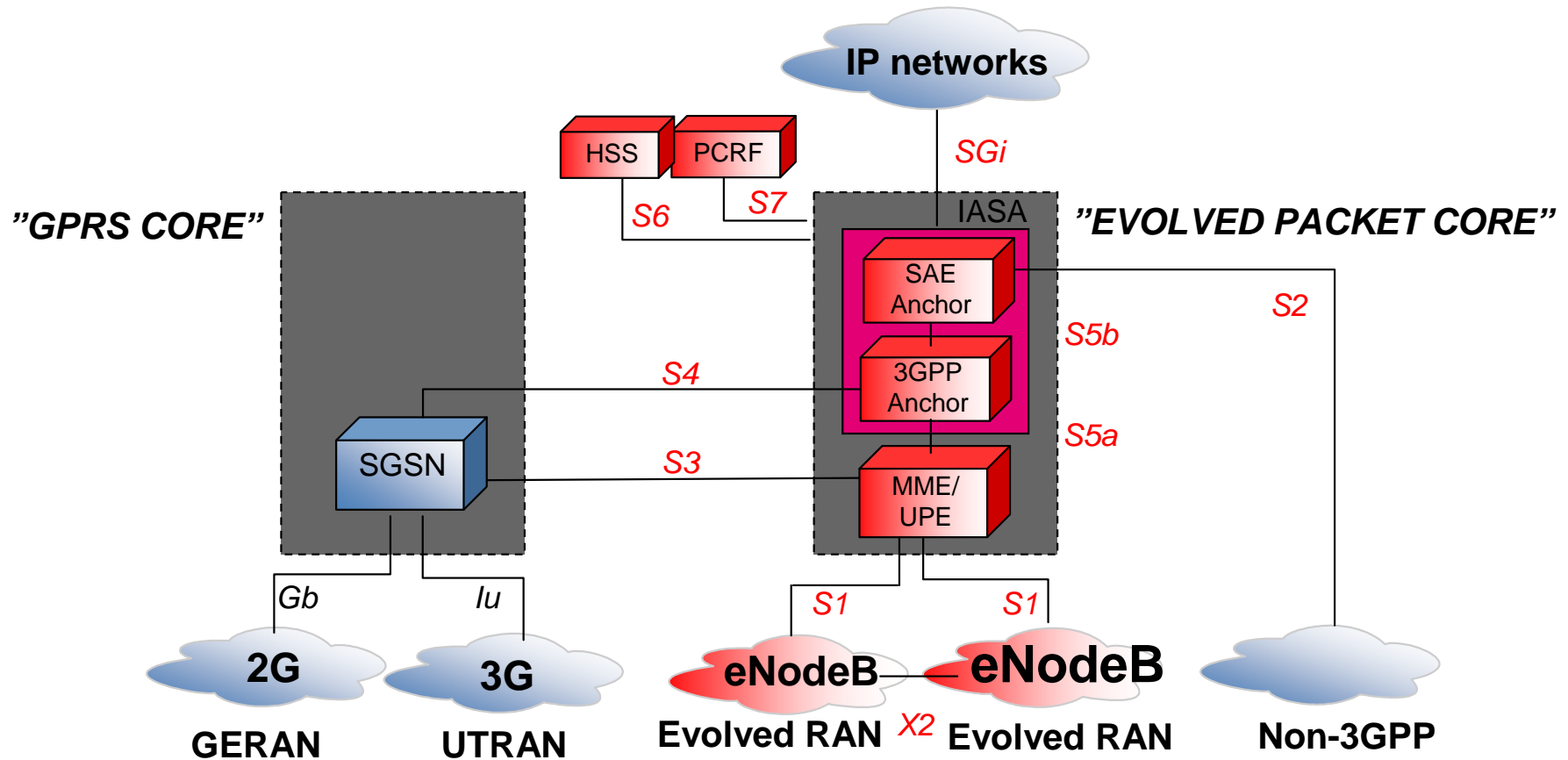
Architecture of an amazing technology



Mobile is a shared media, here NGMN means even more: capacity and BW. New access is a must!

# LTE system overview

## 3GPP architecture



MME = Mobility Management Entity  
UPE = User Plane Entity  
IASA = Inter-Access System Anchor  
HSS = Home Subscriber Server  
PCRF = Policy and Charging Rules Function

# Radio Access Technology Comparison

	CDMA2000	HSDPA	HSPA+	LTE	WiMAX	WiFi
Max user Throughput	Rev B DL: 14,7Mbps	UL: 5,76Mbps DL: 14.4Mbps	UL: 12Mbps DL: 42Mbps	UL: ~50Mbps* DL: ~160Mbps*	70 - 500Mbps*	~300Mbps
† Average user Throughput	~2,5Mbps	~2Mbps	~3Mbps	~15Mbps*	~15Mbps*	30-100Mbps
† Cell Throughput	~2,7Mbps (3x@1,25MHz)	~3Mbps (@5MHz)	~7.8Mbps (2x2 MIMO)	20-60Mbps (20MHz)	30-50Mbps (20MHz)	5 Mbps (802.11b) 35 Mbps (802.11g) 150-200 Mbps (802.11n)
Mobility speed (depend on user speed)	~120km/h	~120km/h	~120km/h	~120km/h (350 - 500km/h - > low throughput)	~120km/h (802.16.e, m)	Mobility not supported
Handover support	Fully supported	Fully supported	Fully supported	Fully supported	Partly supported (802.16.e, m)	Not supported
Roaming support	Fully supported	Fully supported	Fully supported	Fully supported	Partly supported (802.16.e, m)	Partly supported
Coverage	Outdoor 0,5-13km	Outdoor 0,3-10km	Outdoor 0,3-10km	Outdoor 0,3-10km	Outdoor 0,5-10km	Outdoor 100m-2km

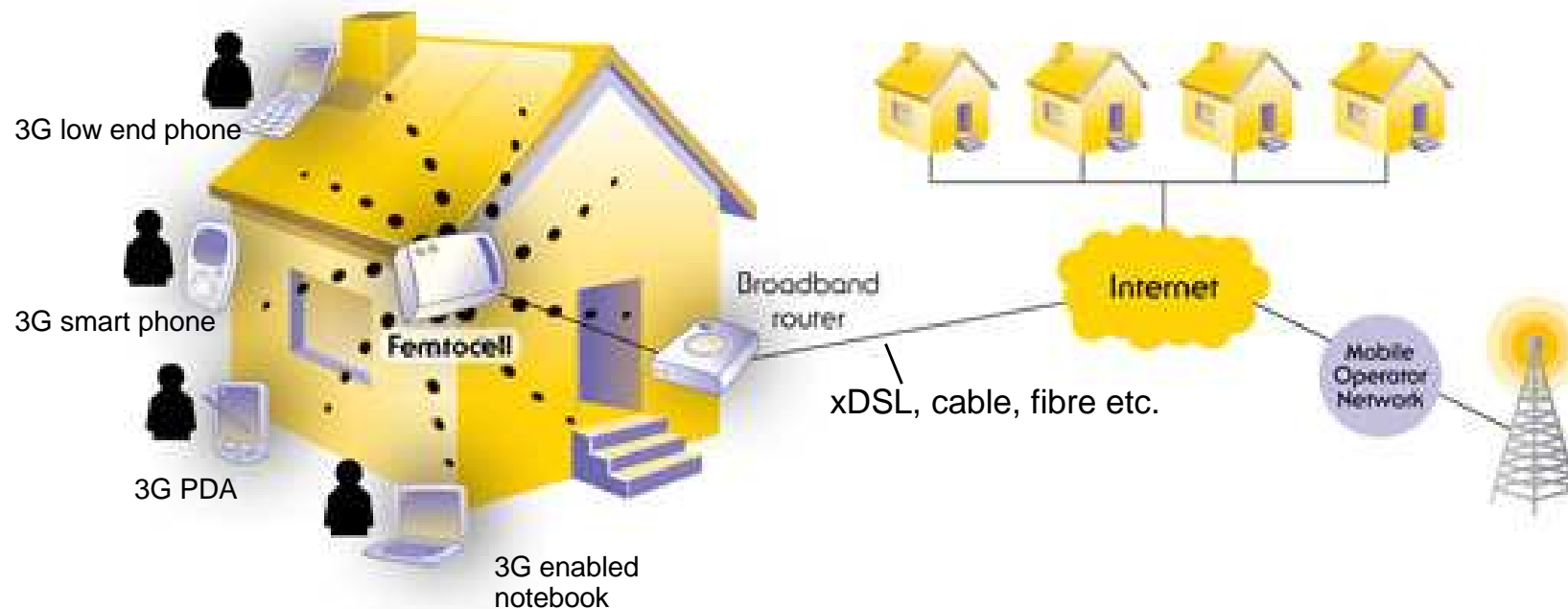
\* Depends on bandwidth and modulation

# WiMAX or LTE?

LTE (3,9G) is for NGMN

- In case of similar frequency band and bandwidth the expected coverage area and cell throughput are nearly the same for mobile WiMAX (802.16m) and LTE
- LTE upgrade path from legacy platform should allow lower OPEX
- Given the size of each ecosystem, LTE should enjoy some advantage over mobile WiMAX (802.16m) by the time we are ready to deploy the technology
- LTE should be able to build upon the very large economies of scale present in the mobile phone market

Femtocell is a 3G access point connecting standard mobile devices to the mobile network via a fixed broadband connection



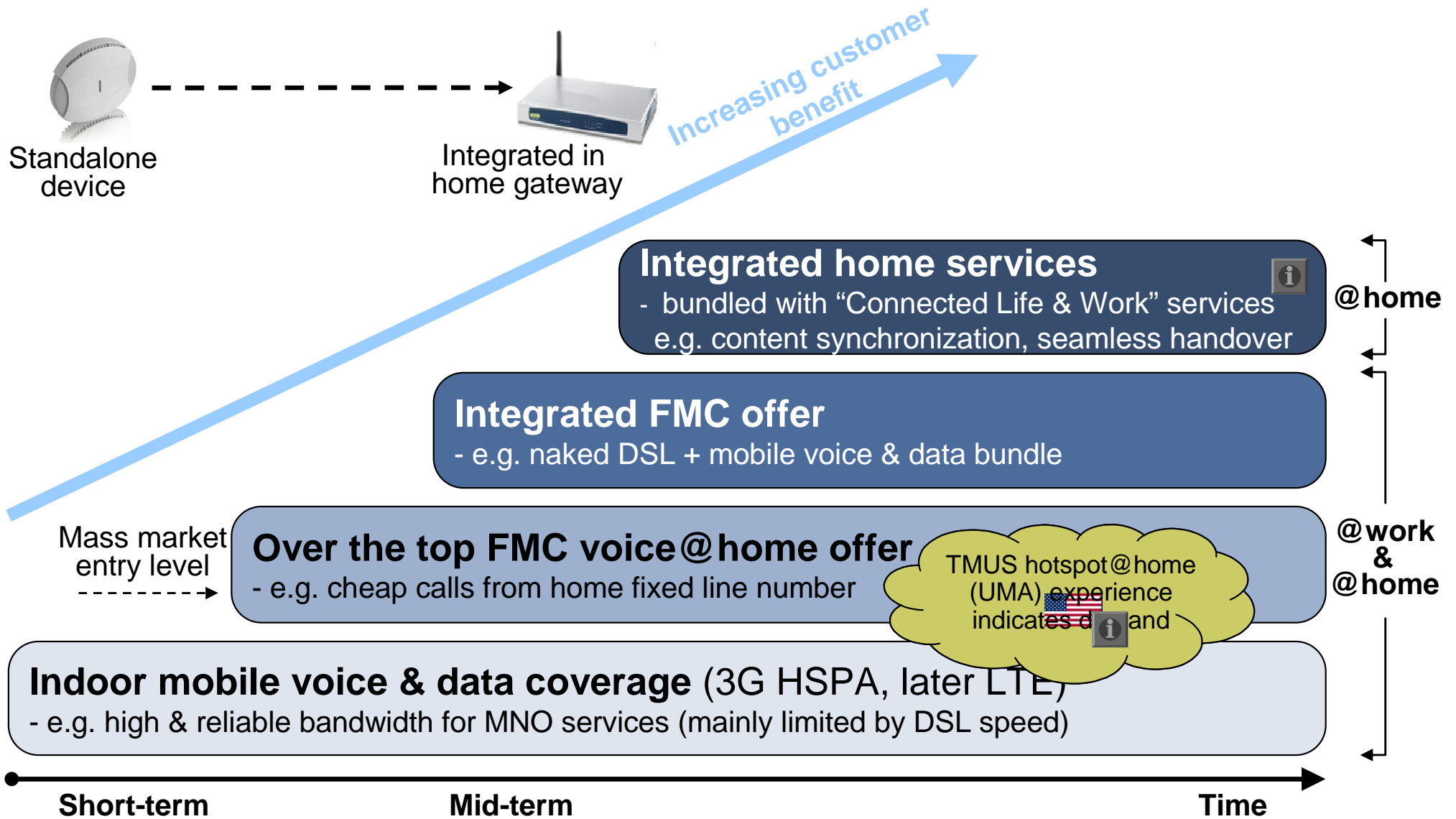
### Technology status

- **Hardware ready** for commercial launch in **2009**
- Lab and friendly user trials ongoing
- **Standardization (3G & LTE) ongoing**
- High OEM **supplier commitment** (e.g. NSN, Ericsson etc.)

### Market introduction

- CDMA Femtocell in commercial use (Sprint) i
- Several operators **announced interest/are in trials**
  - **EU** e.g. SFR, Vodafone, O2, Orange
  - **US** e.g. AT&T
  - **Japan** e.g. Softbank

# For customers Femtocells supplement indoor coverage and in mid-term enable FMC and integrated home services



# 3G Femtocell and WiFi technology should be regarded as complementary and not as substitutes

	WiFi	3G Femtocell
+	<ul style="list-style-type: none"> <li>Mass market for in house connectivity at low cost today (PCs, CE etc.)</li> <li>Unlicensed spectrum free of charge</li> <li>High throughput</li> </ul>	<ul style="list-style-type: none"> <li>End-to-end QoS support of all mobile voice &amp; data services with high in-house coverage quality</li> <li>All 3G devices supported, large device range available today</li> </ul>
-	<ul style="list-style-type: none"> <li>No full support of mobile services (e.g. handover, missing QoS mechanisms esp. relevant for voice, no seamless security)</li> <li>Today limited control by operator (higher control can be implemented e.g. EAP-SIM)</li> <li>Higher power consumption</li> </ul>	<ul style="list-style-type: none"> <li>Seamless service experience &amp; high ease of use</li> <li>Pre-mature technology at the moment</li> <li>SIM card required for non mobile use e.g. for stationary home connectivity</li> </ul>

**WiFi  
+  
Femto**

Reliability issues of shared spectrum

- Complete substitution of WiFi by 3G Femtocell unlikely
- Co-existence of both technologies provides clear benefits:
  - Support of large device and service range
- Integration of Femtocell into WiFi router (or as add-on module) could drive Femtocell adoption and lower costs

UMTS, 3G Femtocell, Bluetooth & Wireless USB compared to WiFi & 3G costs and power consumption



# How to implement NGMN?

## Fixed Wireless Access

### LTE in rural

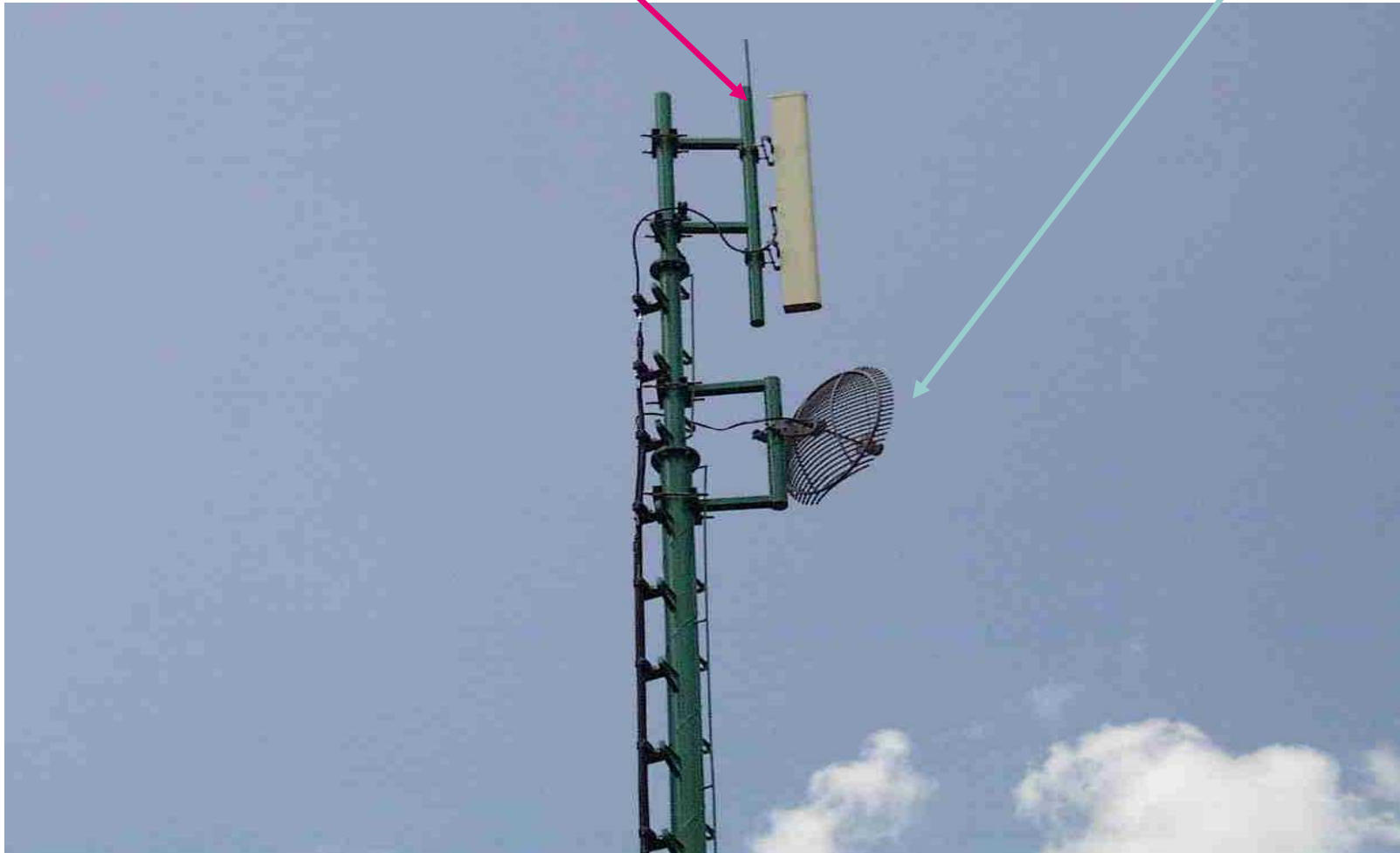
- better than 3G since it supports flexible spectrum allocation from 1,4-20MHz from (450)900MHz-2600MHz
- ubiquitous 2G/3G/LTE reach, roaming, mobility
- complement to metropolitan FTTx and 3G coverage
- standalone network in rural, airborne, vessels (Quicklink etc)
- in-building coverage at remote homes, small villages
- plausible spectrum:
  - 450MHz fragmented and capacity is limited (spectrum1,25-5MHz)
  - 800MHz digital dividend (100MHz expected/should be used for mobile)
  - 900MHz GSM refarming: quick but capacity is limited

# Example for cost effective network rollout

## Offset-repeater

coverage  
antenna

link antenna



# Regulatory aspects

## ➤ New spectrum for LTE


- 2500-2690 MHz band is the primary band for LTE in Europe
  - In Hungary this band has a "planned (not assignable)" status and interfered by the especially high performance meteorological terrestrial radars operating in the 2700-2900 MHz band
  - Licensing is expected earliest at the end of 2009 in such a way, that interference conditions will be taken into account in the bidding process
- „Digital Dividend” (790-862 MHz) according to WRC-07 decision after 2015 in Hungary (refarming the UHF band)
  - Earliest date (e.g. 2013) should be more beneficial for the mobile industry

## ■ Refarming current mobile bands:

LTE is expected in 900/1800 MHz & 2,1 GHz

- EU regulation does not allow UMTS900 yet (repeal of the GSM Directive is further delayed), so 900 MHz and 1800 MHz refarming is not possible yet, 2.1 GHz refarming is not on the regulatory agenda yet

## ➤ LTE femtocell

- .....  Femtocells should be taken out of the scope of frequency fee regulation otherwise 3G station fee would be excessive, risking the BC for femtocells

# Rural settlements FWA applications

LTE can support 100Mbps user speed  
LTE can support maximum 400users per cell  
LTE can support 20-60Mbps cell throughput

This is  
excellent for 2Play  
good for 3Play  
good for 4Play

3G HSDPA can support 2

## T-Mobile web'n'walk Box IV

Hotspot für zu Hause und im Büro

Details Eigenschaften Zubehör Handy vergleichen >



- HSDPA bis 7.2 MBit/s (ca. DSL 6000)
- HSUPA bis 2.0 MBit/s (ca. DSL 16000)
- LAN- und WLAN-Datenverbindung

**Inklusive 3 Gutscheine mehr >** **Empfehlen und verdienen**

Sofort lieferbar  
Handypreis in allen Tarifen

**4,95 €**  
im web'n'walk@home 100

# Is LTE worth it?

Depends on the traffic volume but

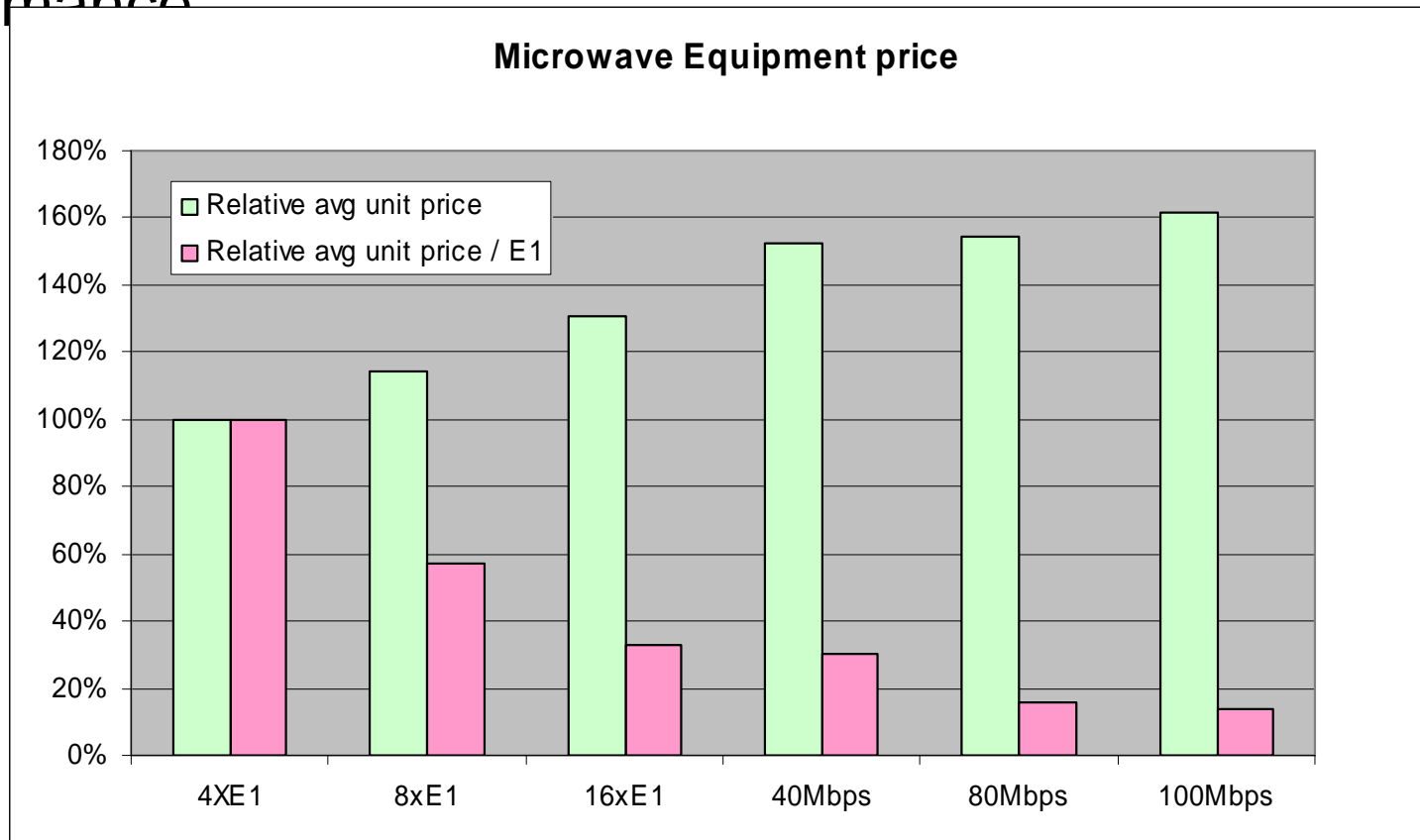
Cost per MByte falls because:

- better spectrum efficiency: HSDPA 2bit/Hz/s while LTE has 5bit/Hz/s

- coverage range is ~3G plus better fit to lower frequency bands

- LTE may enjoy volume advantage

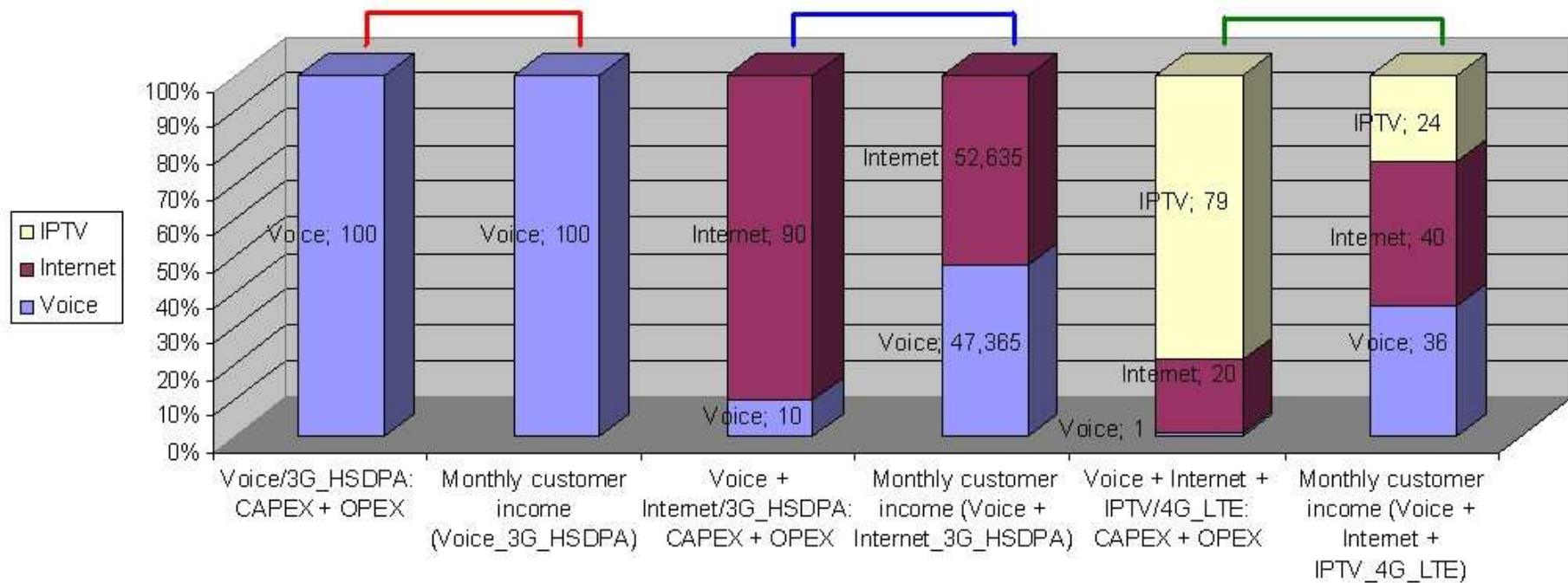
- Node B cost and TRM cost increase not proportional to performance



# Is LTE worth it?

## 3Play costs

The distribution of network development costs and the monthly customer income relevant to services



# How to implement NGMN?

## Femtocell

### Voice:

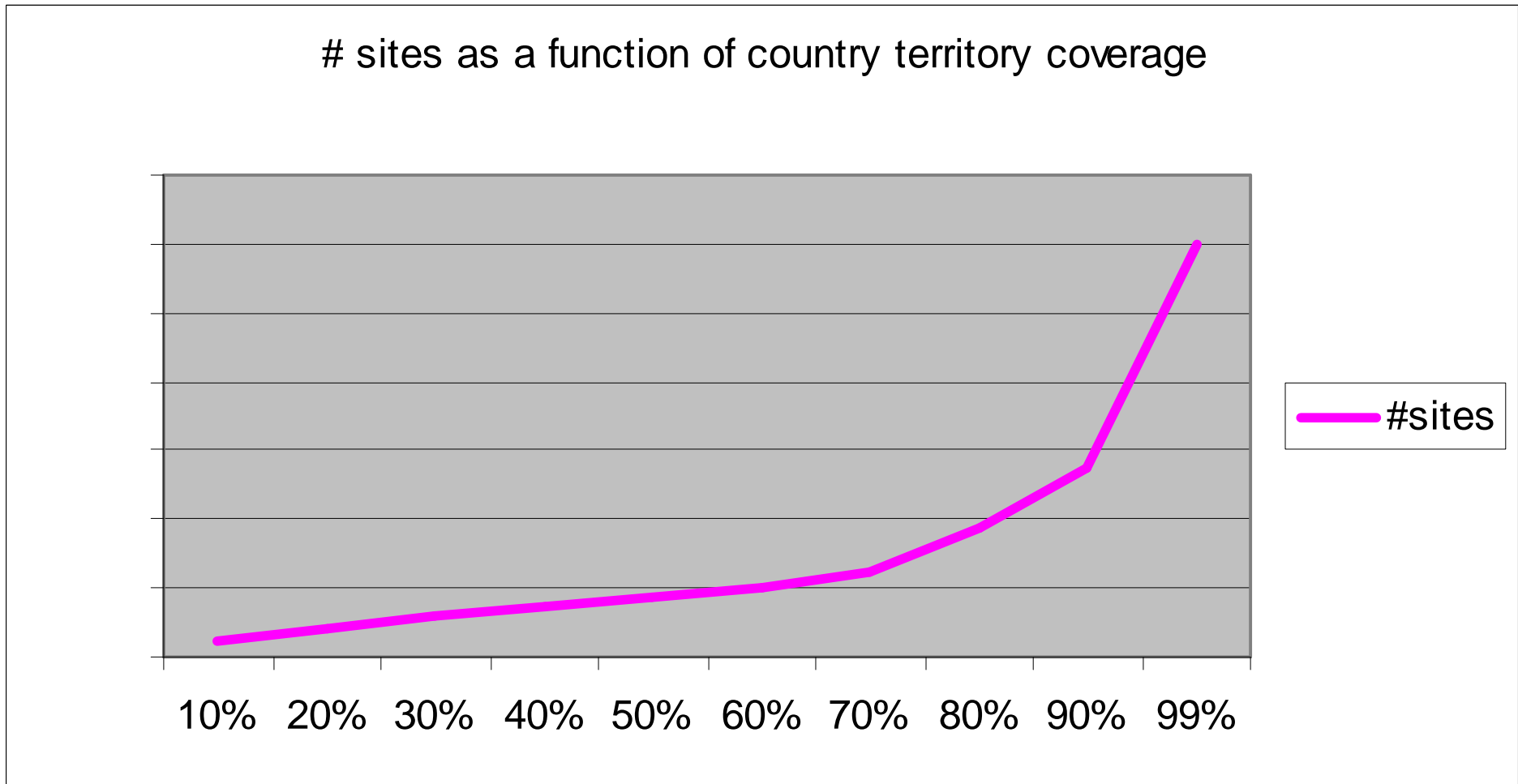
- ubiquitous voice reach,
- FMC: one terminal, one service/subscribtion, home zone, mobility,
- PSTN replacement option,

### Data:

- unified access/one ISP,
- countrywide/LTO areas, (and beyond?),
- cheap mass solution for low bandwidth needs
- hot spot deployment like WiFi but better integrated
- concerns:
  - ADSL2+ or CATV or SHDSL or FTTx access line is needed for data,
  - usage of femto for data at home if fixed broadband&WiFi is available?

Femto only LTE?

# What does it mean in terms of costs?



LTE is best supporting technology for fallback to 2G/3G=> one integrated wireless network supporting mobility&roaming as well