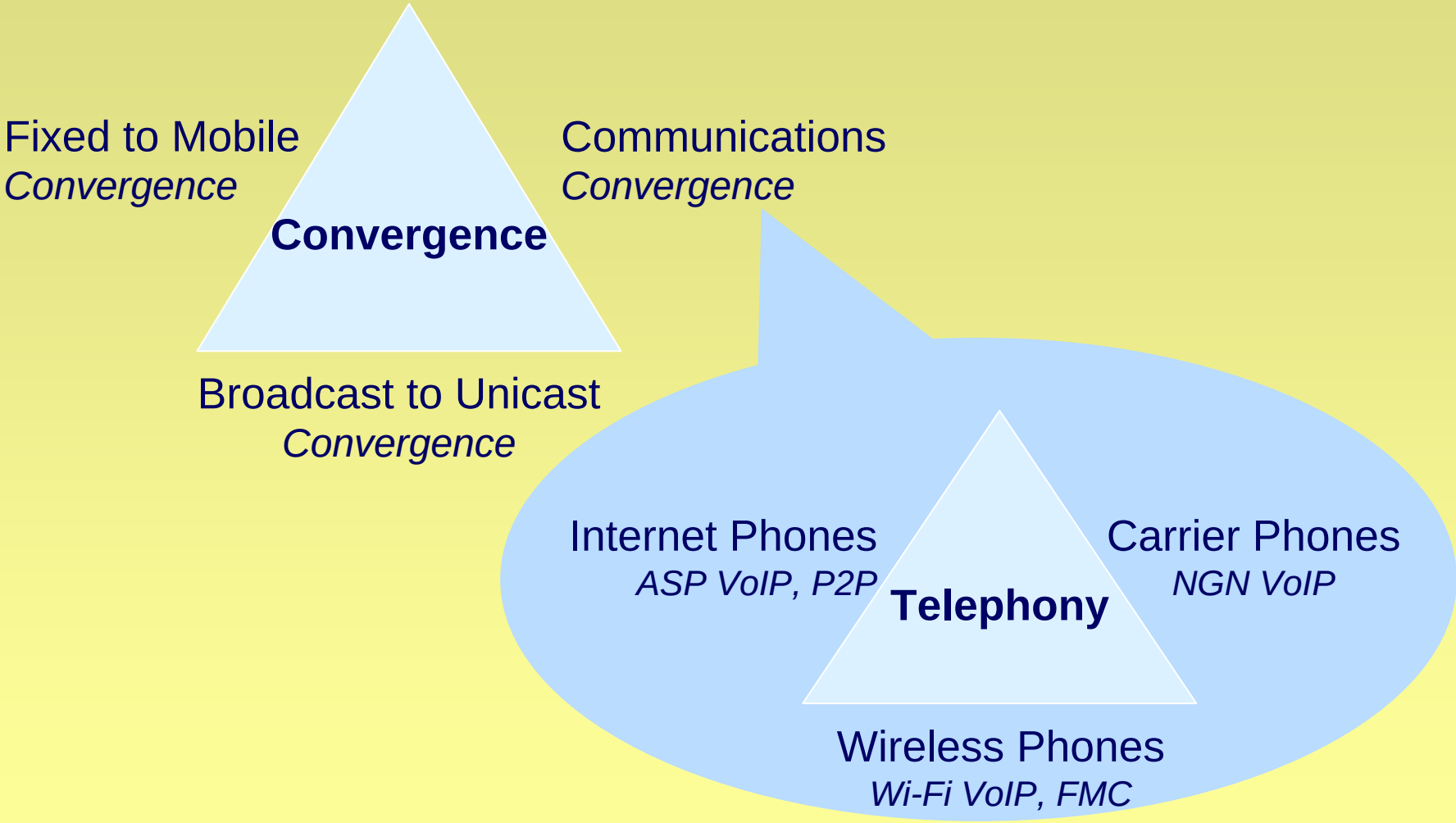
Disruptive Technologies,
Between Hypes & Opportunities:
VoIP P2P & Broadband Wireless

Maurizio Dècina, Politecnico di Milano

Topics

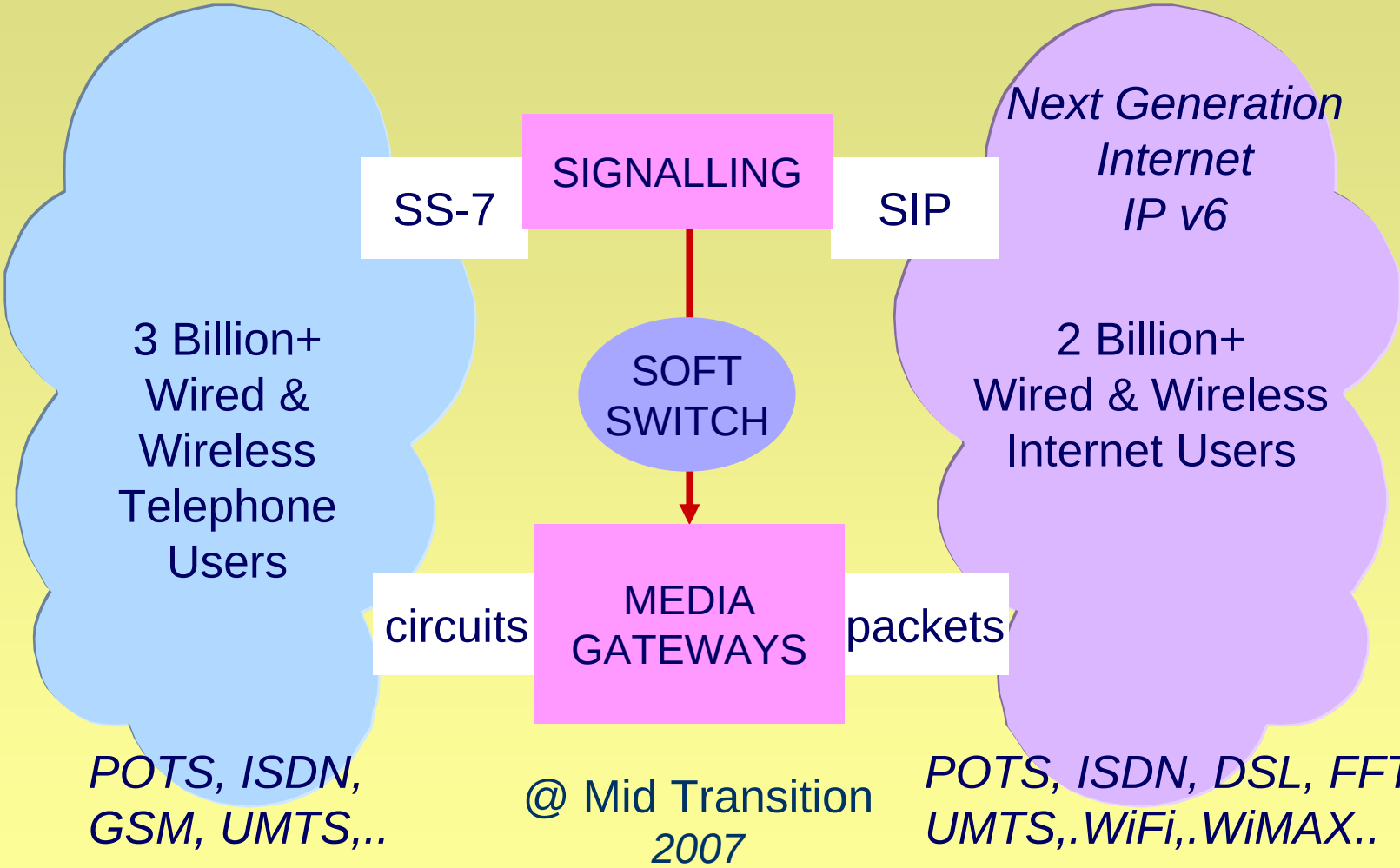
- Convergence & Internet Telephony
- Peer-to-Peer Telephony
  - Skype
- Broadband Wireless Technology
  - WiMAX, MobileFi

Convergence & Internet Telephony



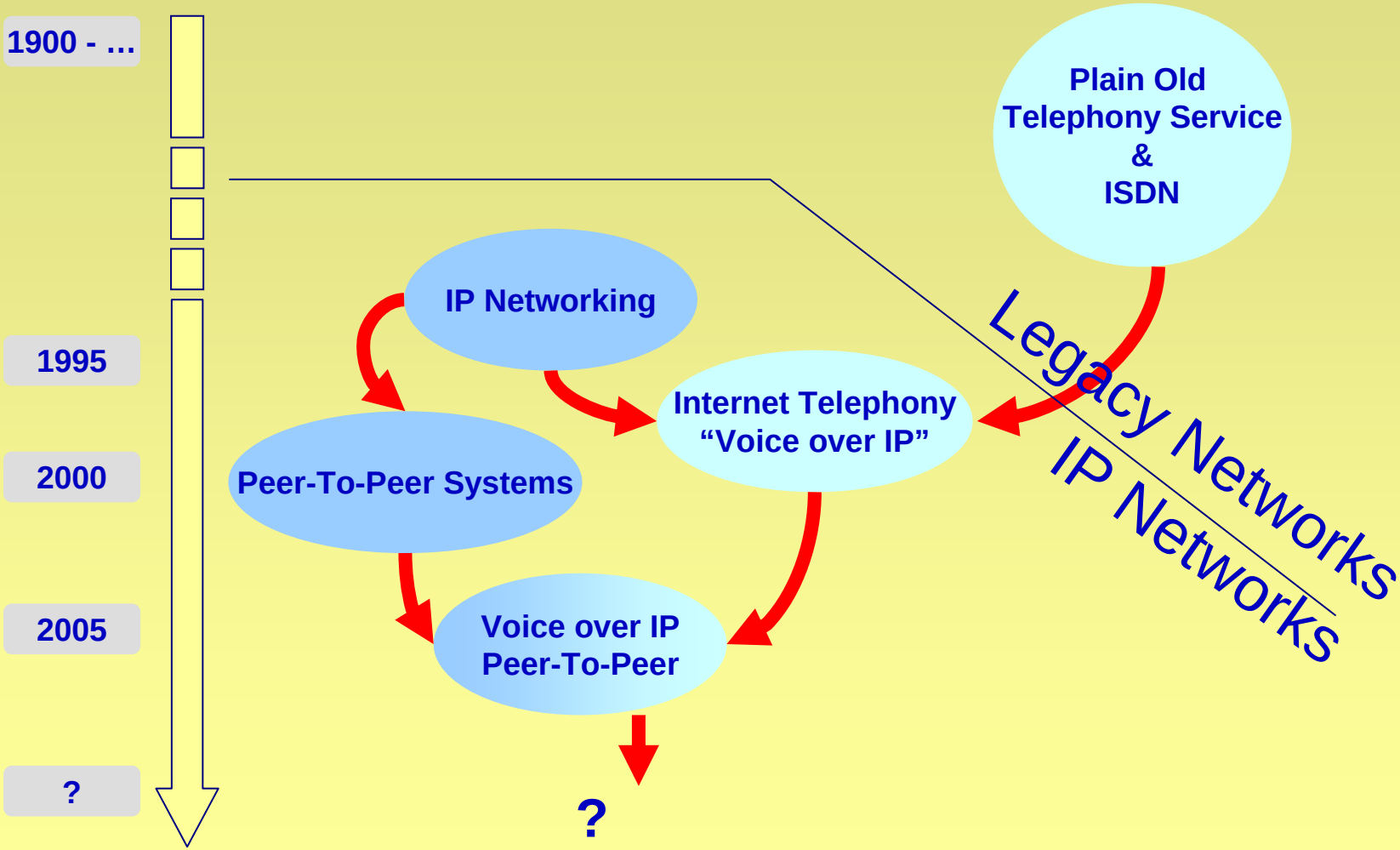
Source: M. Dècina, 2004

Telephony/Internet Transition - *2002-2012*



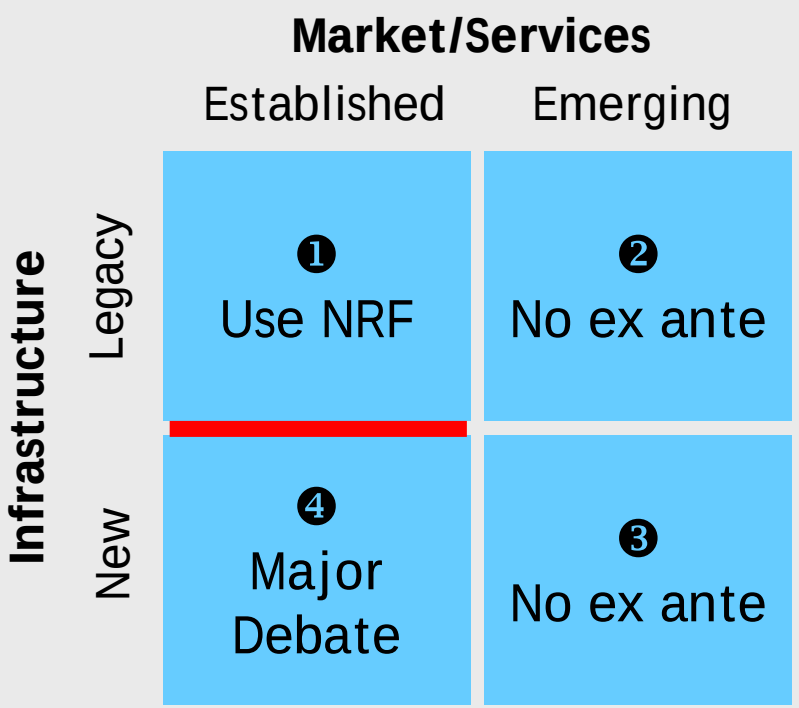
Source: M. Dècina, 2002

Evolution of Telephony Technology



M. Dècina for ThinkTel, October 2005

New Regulatory Framework & FCC rules



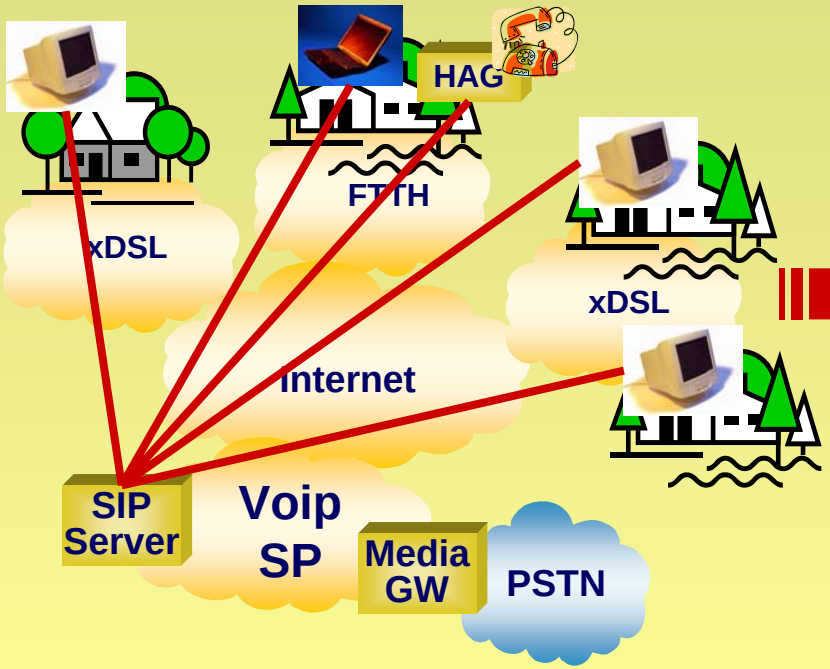
- VoIP ➡ @ border ❶ / ❹
- Fixed NGN ➡ @ ❸ & ❹
- Mobile NGN ➡ @ ❸ & ❹
- Fixed Mobile Integration ➡ mainly @ ❸

Source: Ovum & Indepen, 2005

On August 5, 2005, FCC specified that interconnected VOIP providers (i.e. VoIP providers that interconnect with the PSTN) have to be considered "Telecommunication Carriers under CALEA" and then must facilitate wire taps (legal interception) within 18 months

From Client-Server VoIP, to Peer-to-Peer VoIP

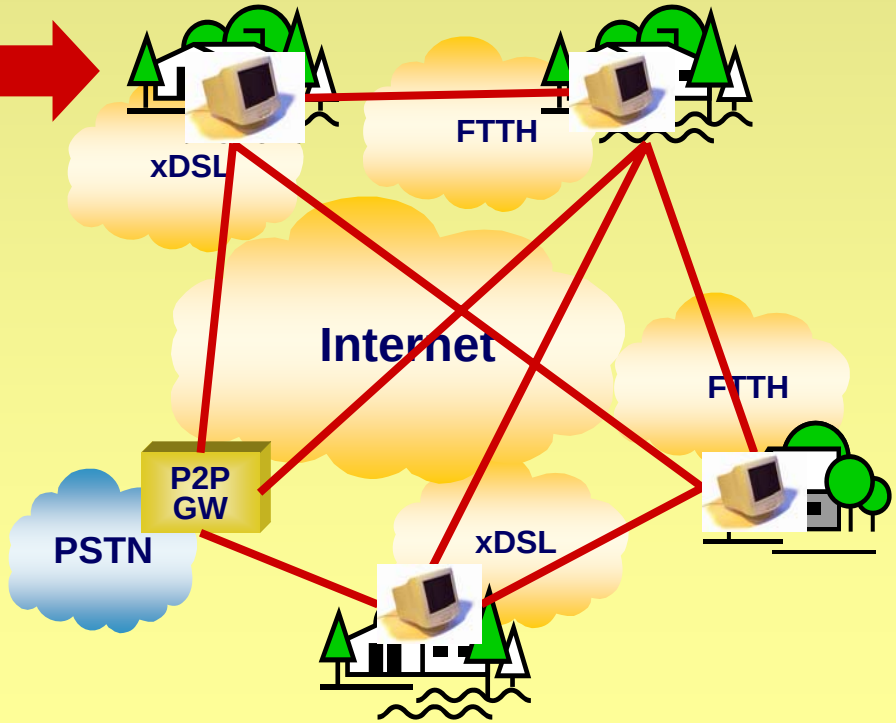
Telco VoIP Model



- SIP based VoIP
- Client-Server
- Need of centralized servers for user registration and call handling

- Peer-to-Peer
  Overlay Network
- No centralized servers

P2P VoIP Model



Peer-to-Peer Telephony: Skype

- 55 M users, 170 M dowloads
- Proprietary SW and protocol, POTS quality, strong privacy
- Free PC-to-PC calls
- 1.2 M users of “SkypeOut”: PC-to-Phone
- “SkypeIn” & “Voicemail”

September 2005

- September 12, 2005 – eBay Inc. has agreed to acquire Skype Technologies for approximately $2.6 billion, plus potential performance-based consideration

Skype - Networking Architecture

Super Nodes

- They are established after acceptance test by Skype

-They have public IP address

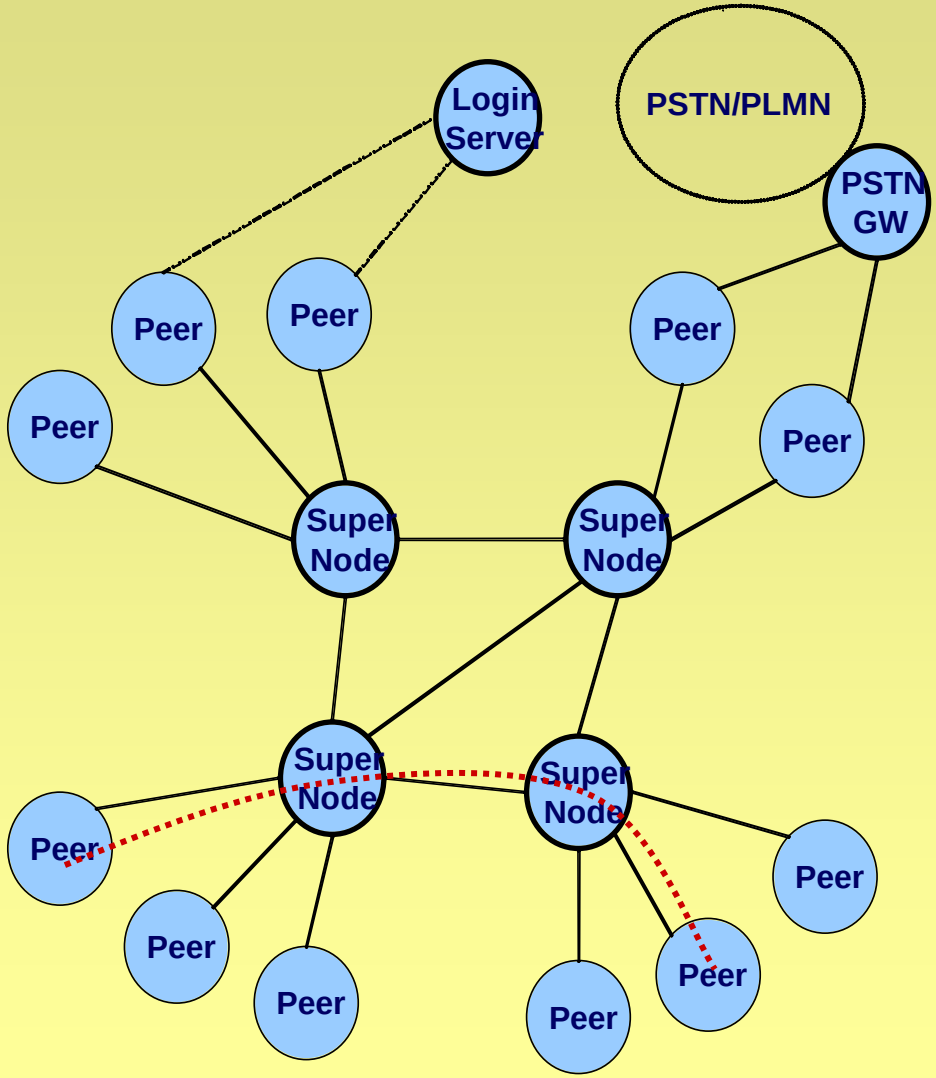
-They offer storage, processing & bandwidth

-Each Serves 100s Peer Nodes

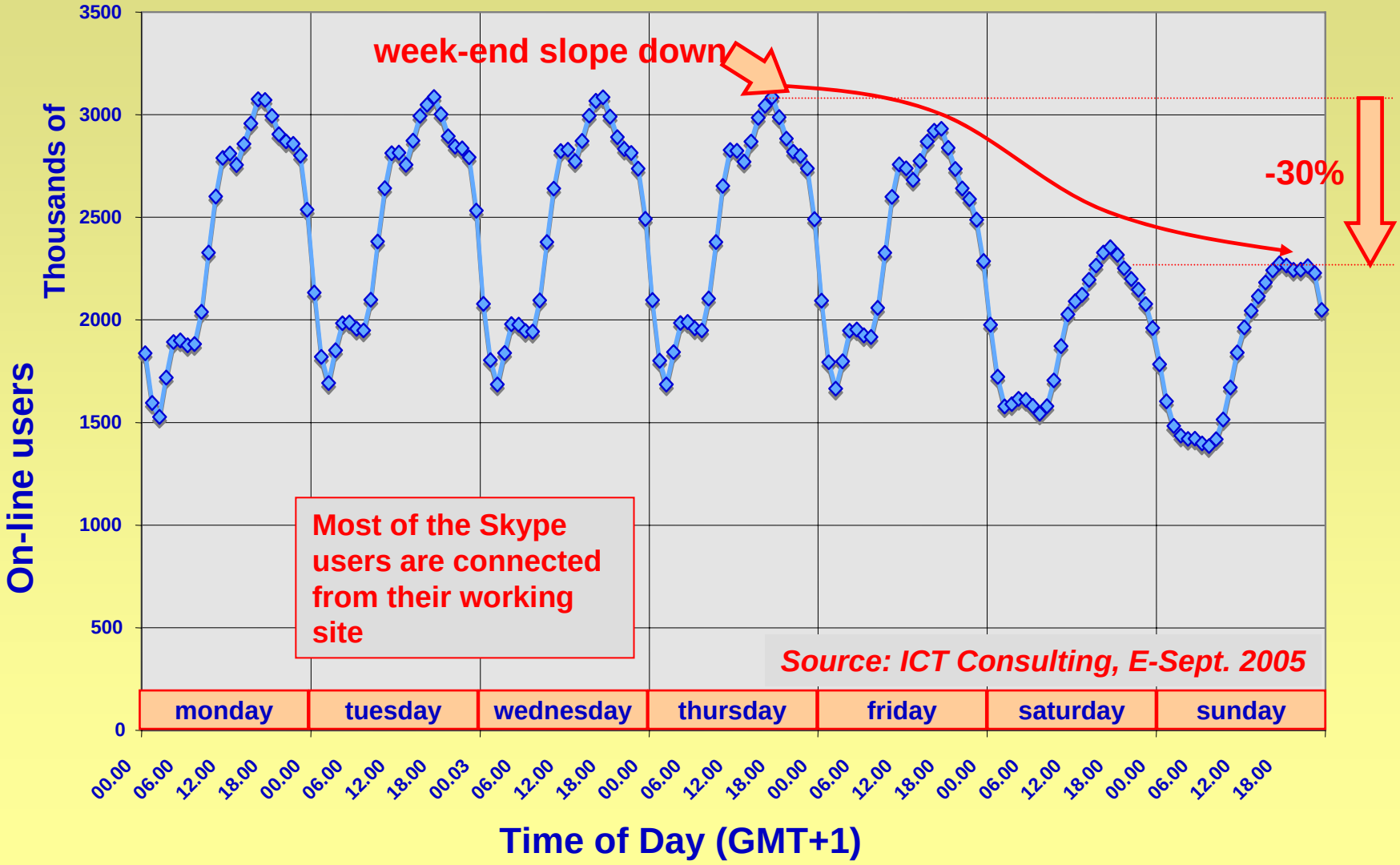
-They route encrypted calls

-They execute "NAT" of private IP addresses

-They exploit p2p protocol



Skype Worldwide On-line Users (1 week plot)

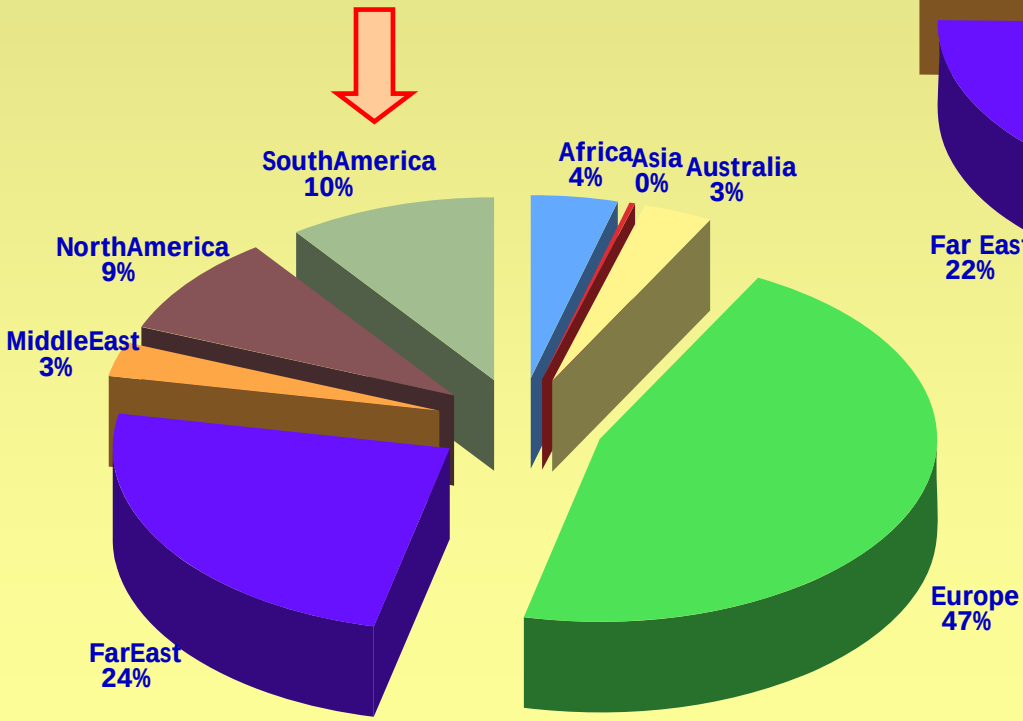


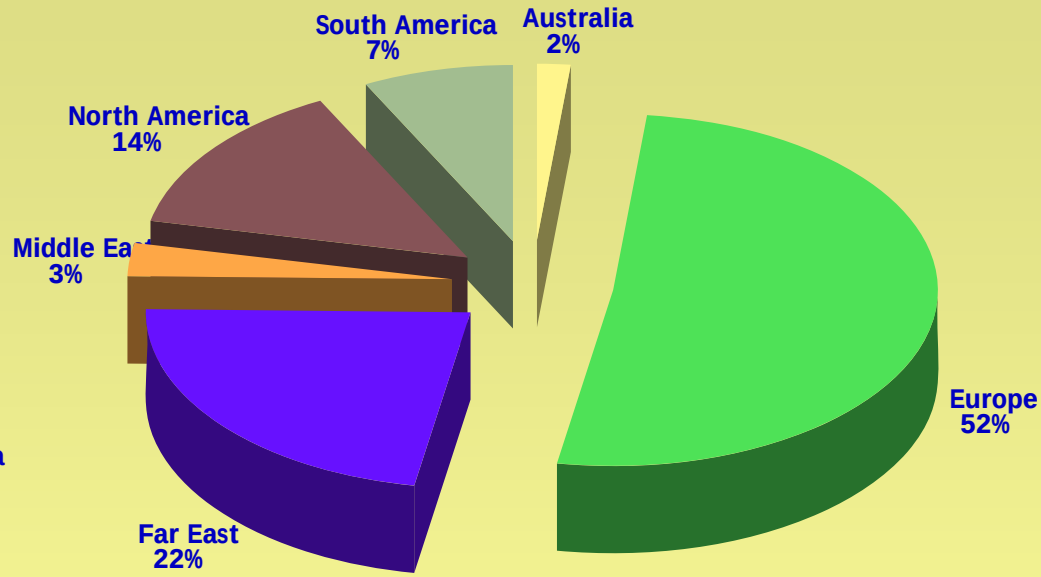
M. Dècina for ThinkTel, October 2005

Skype Worldwide Maps

Peer Map by World Region

(Estimated by "ICT Consulting" super-node on 22nd of August, 2005)



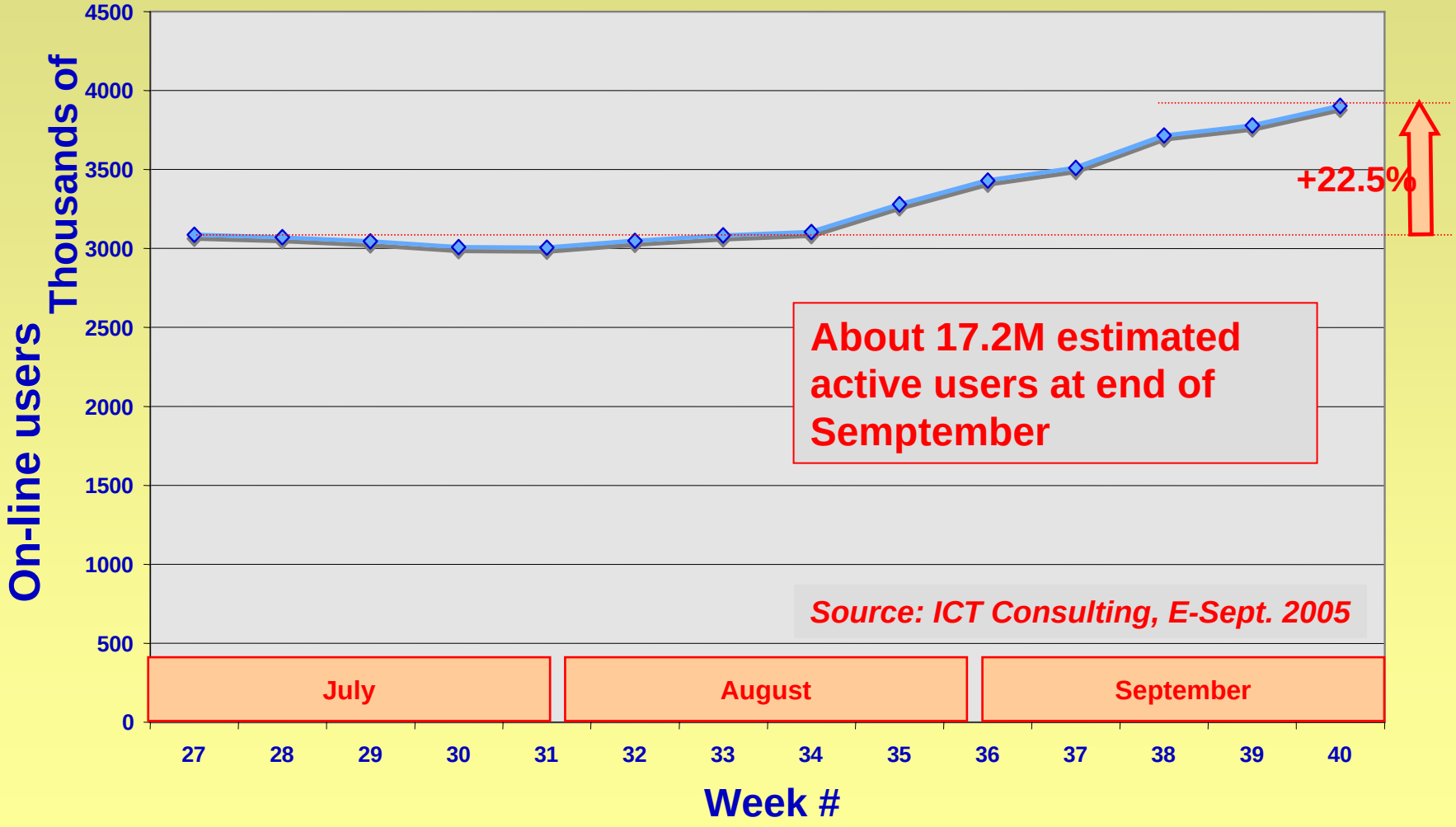


User Map by World Region

(reported by http://eurotelcoblog.blogspot.com referring official data received from Niklas Zennstrom)

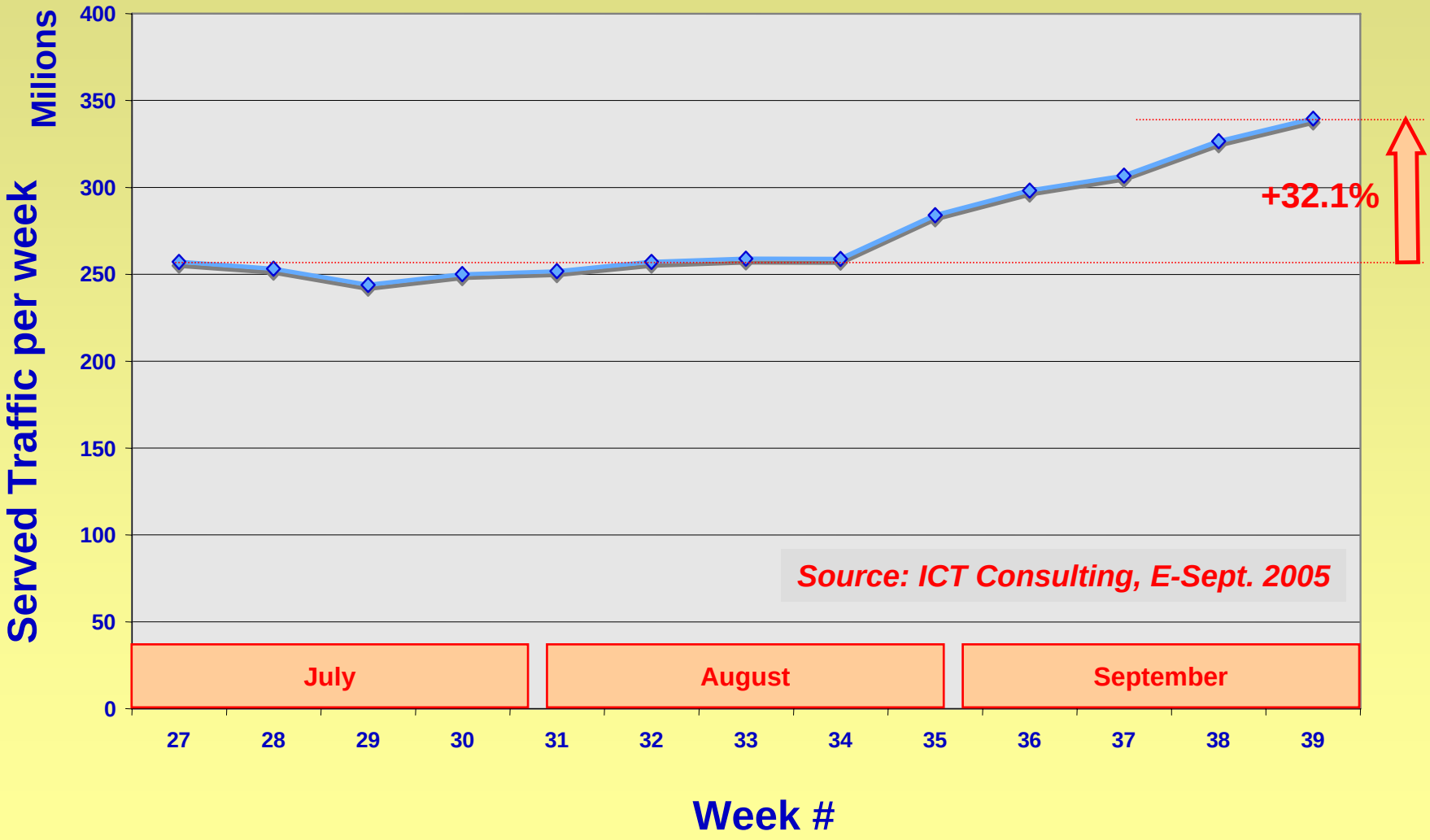
M. Dècina for ThinkTel, October 2005

Skype Worldwide On-line Users - 3Q 2005



M. Dècina for ThinkTel, October 2005

Skype Served Traffic Minutes - 3Q 2005



M. Dècina for ThinkTel, October 2005

Skype – Growth Limits

- To offer “acceptable” voice QoS, Skype exploits today two types of charge-free Resources
  - Super Nodes Resources
  - Residual free Bandwidth on Internet Backbones

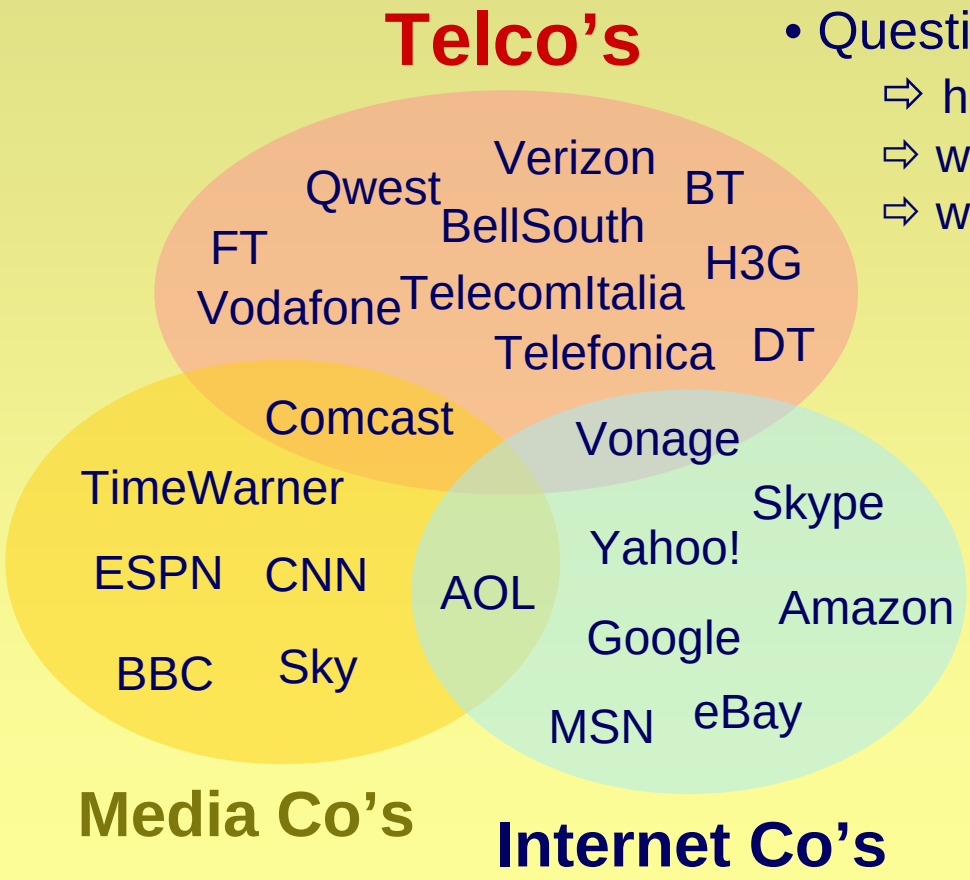
- Skype has serious limitations to grow by keeping the above free assets. Today (September 2005) Skype manages about 1-2 million of simultaneous telephone calls in the Internet. Each Super Node routes about one hundred encrypted calls.

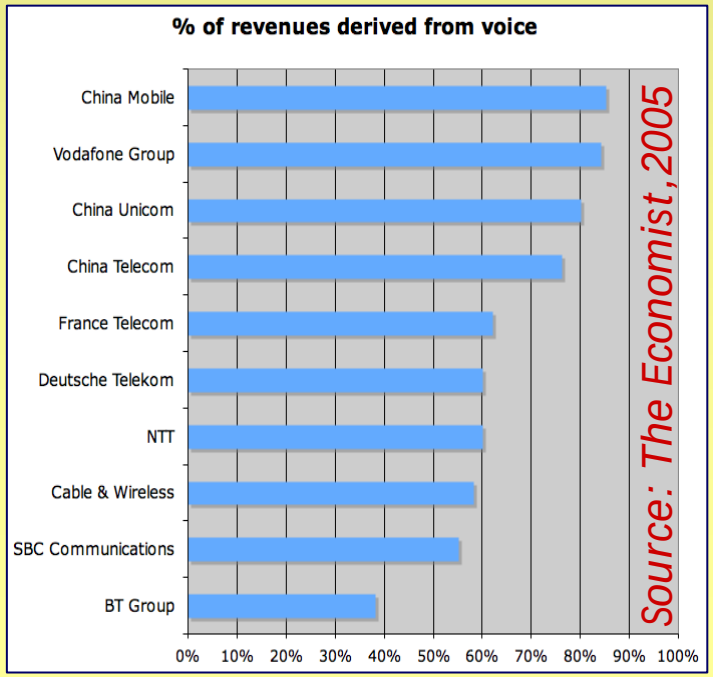
- If the number of calls grows, Skype will be forced to
  - Route and pay for QoS (especially, delay) guaranteed Internet routes (i.e., IP/MPLS routes)
  - Give very stringent performance requirement to establish Super Nodes, and/or provide for powerful Skype owned Super Nodes (i.e., network Routers/Gateways)

- Another important Issue about Skype is Legal Interception Capability

VoIP Future - Who's Going to Risk?

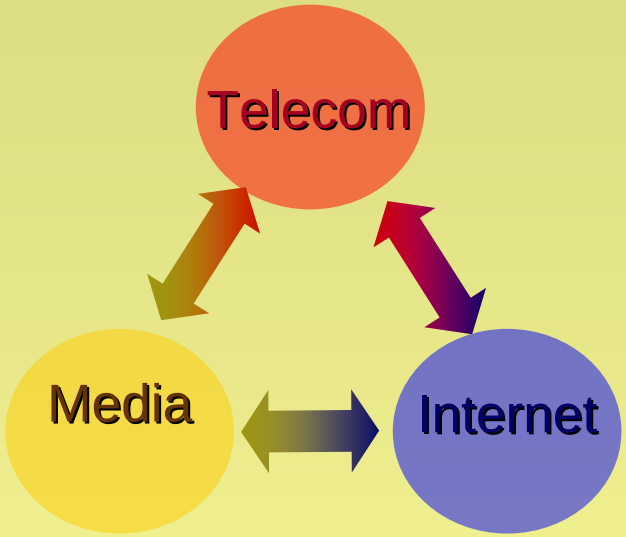
- VoIP will wipe out old telephony
- Voice revenues will shrink dramatically
- Questions are:
  - ⇨ how long will it take?
  - ⇨ who's going to risk more?
  - ⇨ which strategy for Telco's?





M. Dècina for ThinkTel, October 2005

Telco's Moving to "New Wave Business"

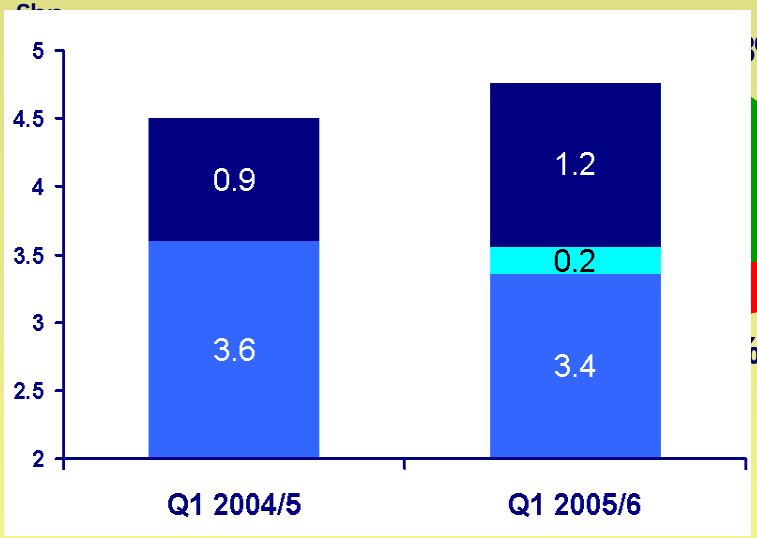


From October 3, until December 31, 2005, calls to 30 popular international destinations with *BT Communicator*, such as the United States, Australia, Spain and France will cost just 0.5p a minute. A 60 minute call to a US landline, which would cost 72p with Skype, would cost only 30p with BT.

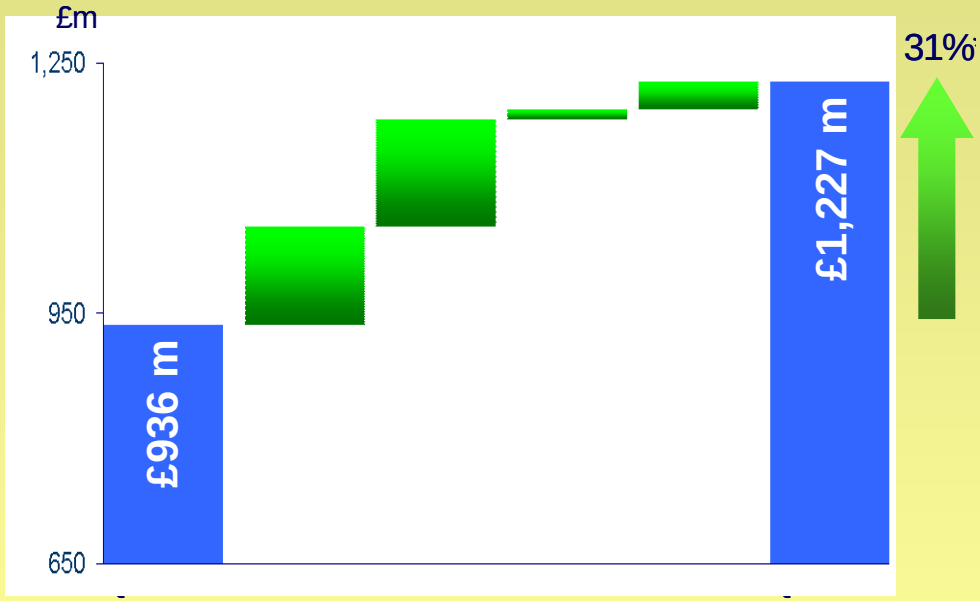
- Telco's
  - Need to accelerate network transition to IP technology: the NGN platform
  - Need to accelerate creation of Fixed to Mobile Platform & Market Convergence
  - Need to enhance capacity to supply networked IT and Value Added Services (a lá BT's "New Wave Business")
  - Need to prepare for new business models, partnerships and acquisitions, to leverage value of their access & interconnection infrastructures, in the value chain for delivery of networked services to the end user

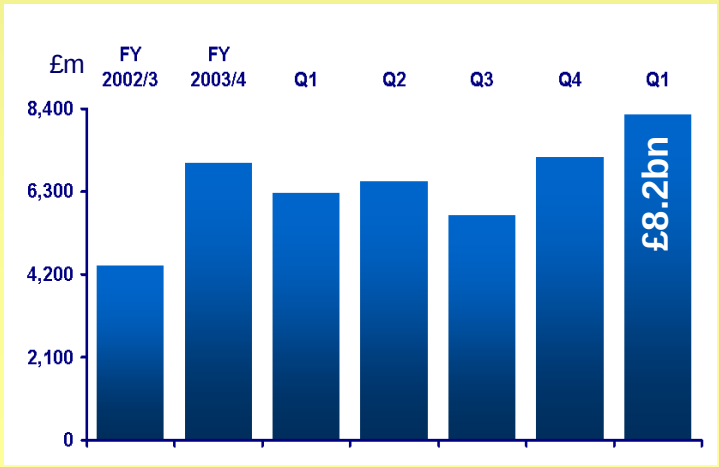
BT in search of New Wave Revenues: Q1 05/06

Q1 2005/6 - Group turnover



Q1 2005/6 - New wave – strong organic growth





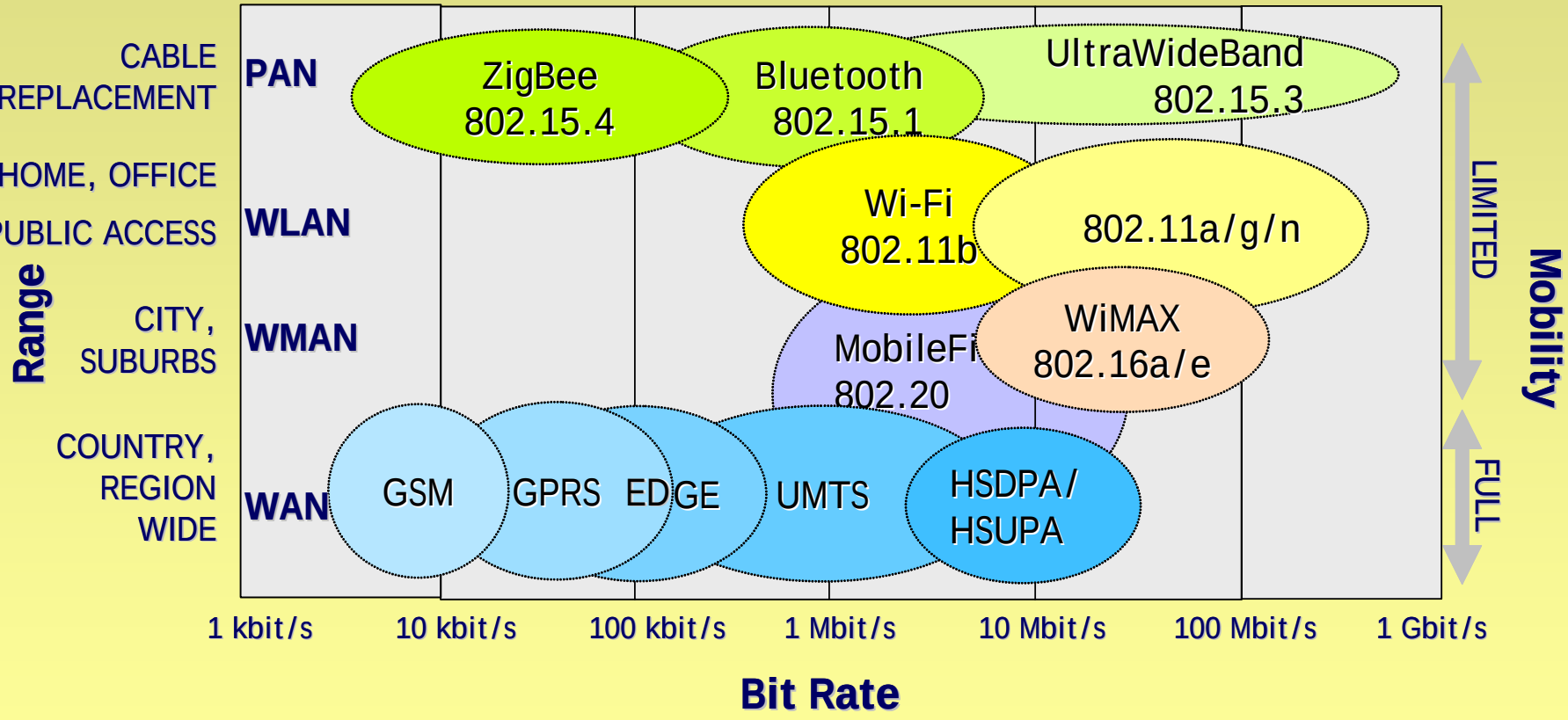
Source: BT, July 28, 2005

Networked IT services
Sales Order Value of contracts

Topics

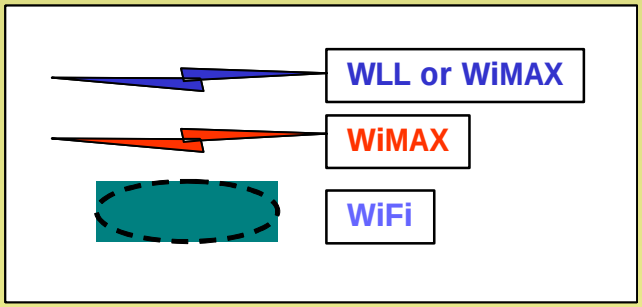
- Convergence & Internet Telephony
- Peer-to-Peer Telephony
  - Skype
- Broadband Wireless Technology
  - WiMAX, MobileFi

Evolving Wireless Communications



Source: M. Dècina, 2004

Indoor/Outdoor Coverage: WiFi plus WiMAX



Personal Hot-Spot

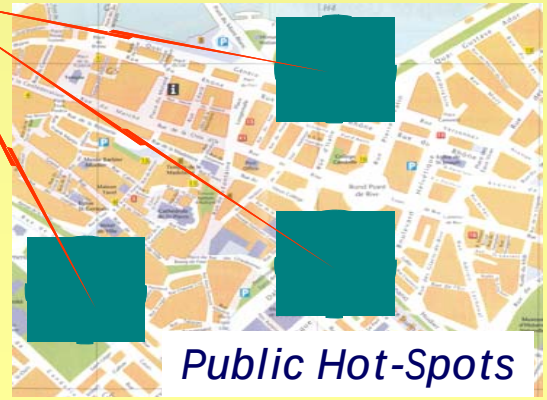
Source: Siemens Communications, 2005

The Internet

Residential Hot-Spots

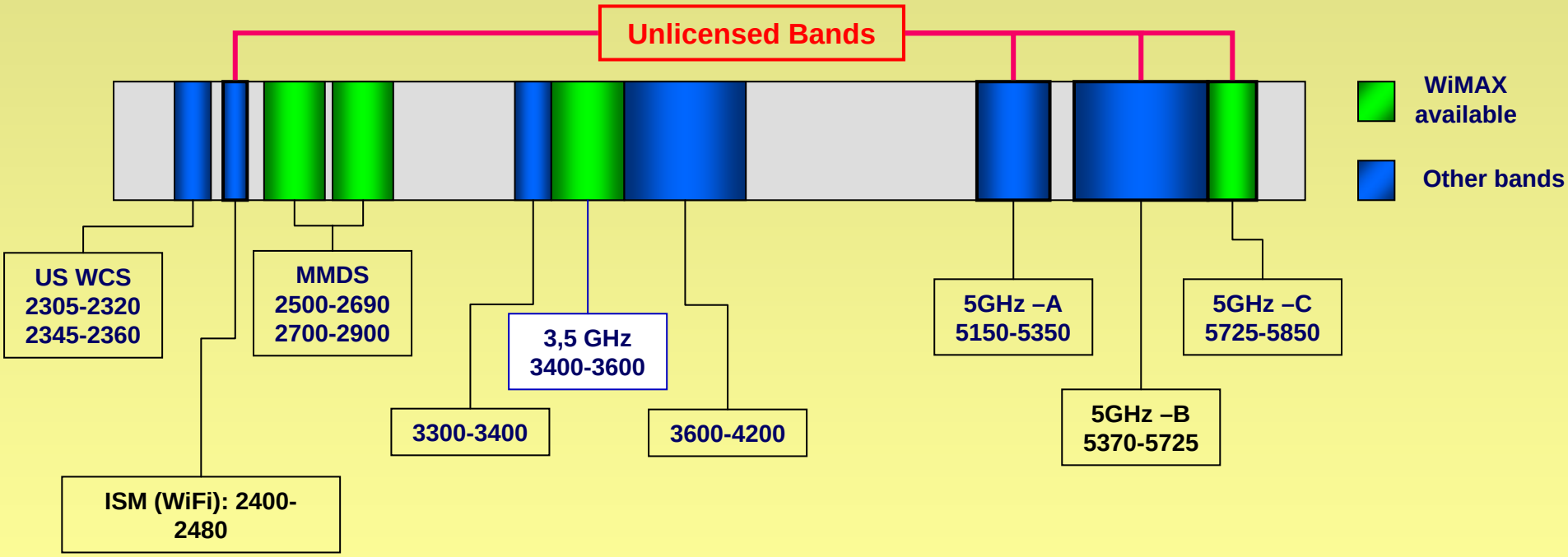
Nomadic Hot-Spots

Corporate Hot-Spots



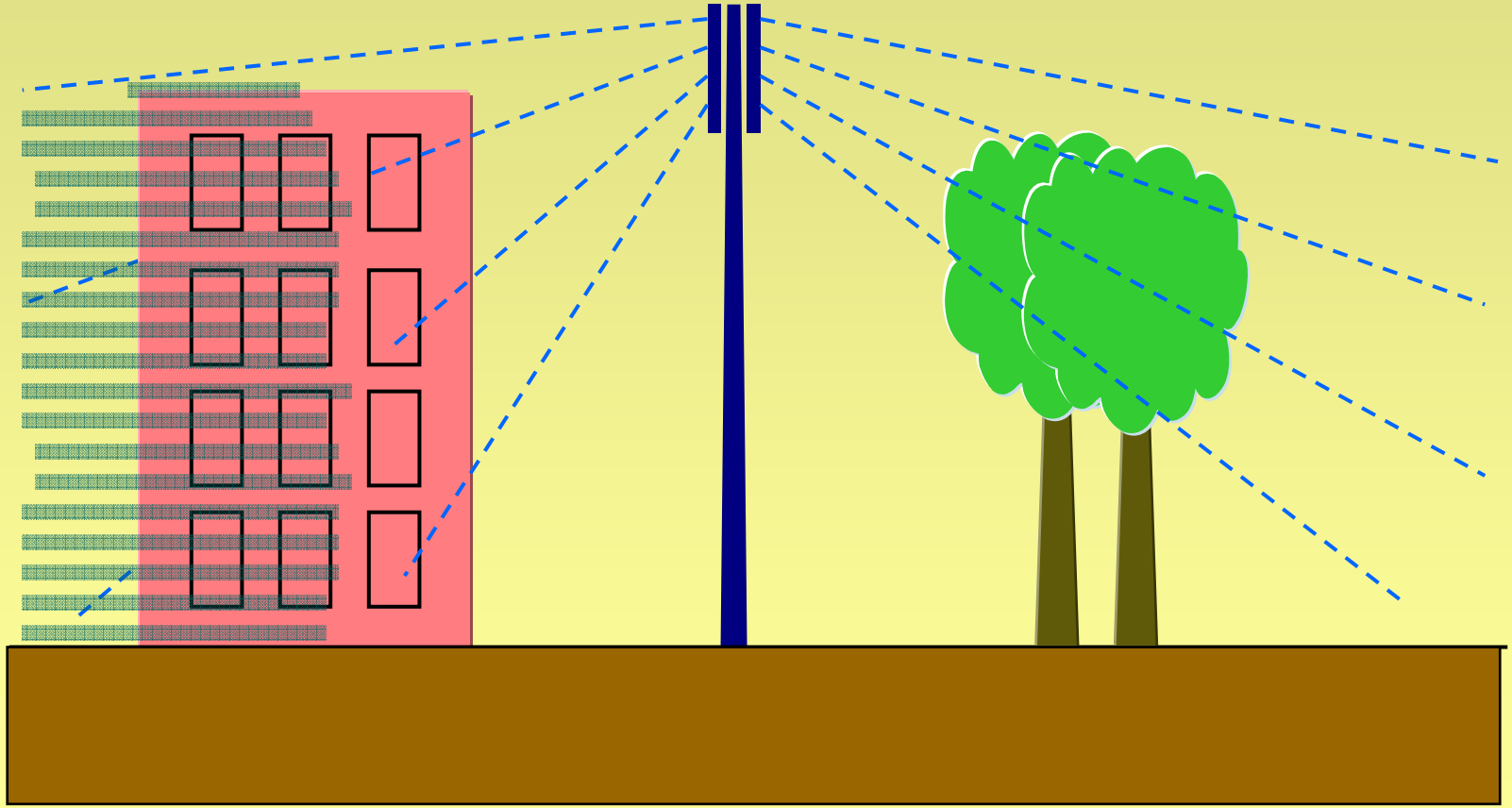
Public Hot-Spots

WiMAX Spectrum Allocation



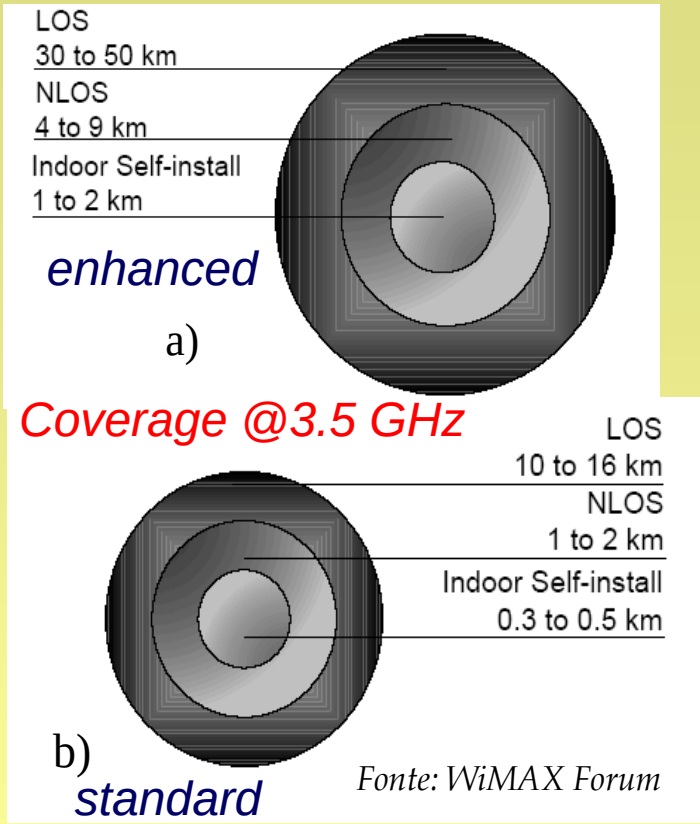
Source: WiMAX Forum, 2004

Indoor/Outdoor Coverage: NLOS at 3.5GHz



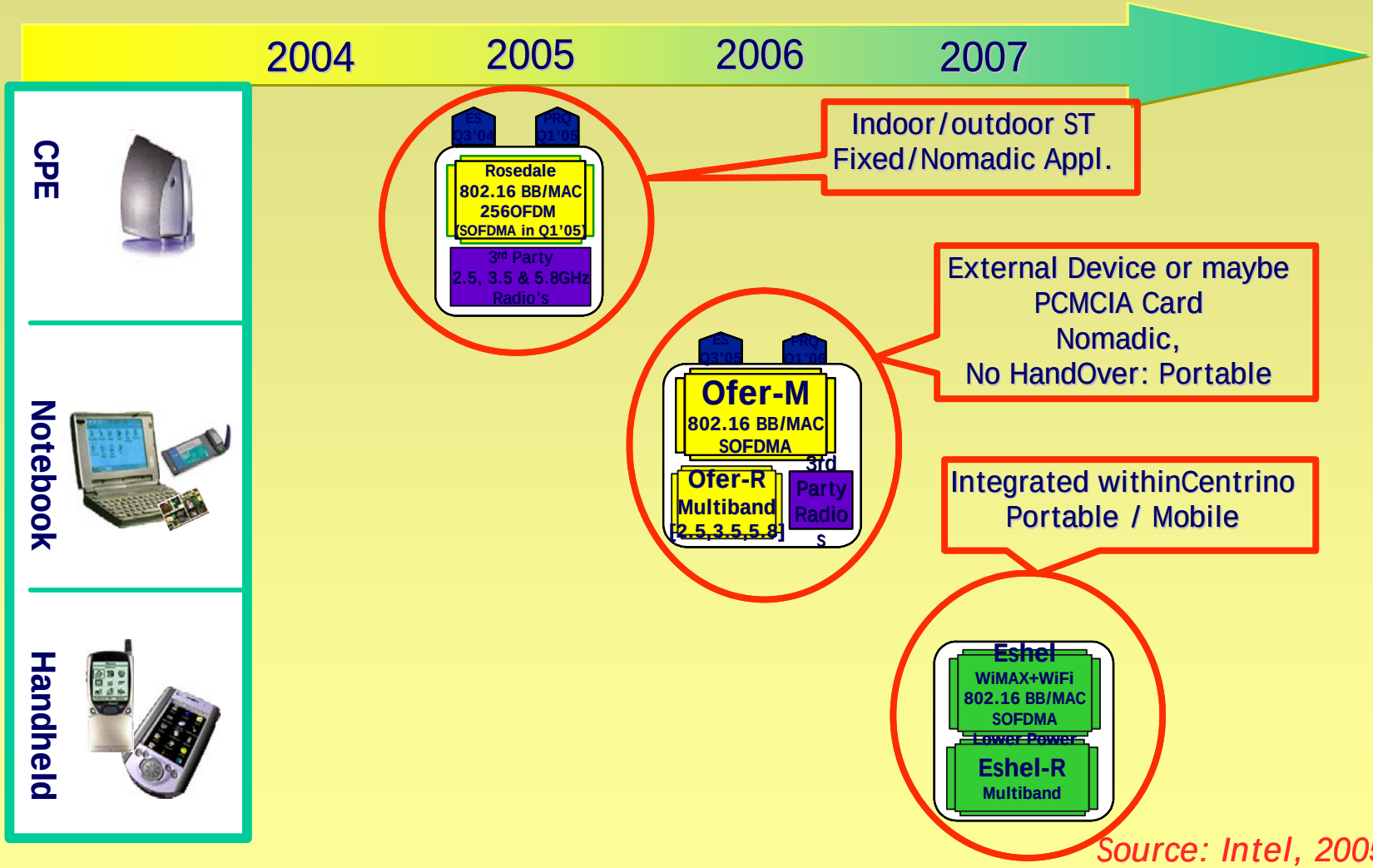
WiMAX Technology

	802.16 – 2004	802.16e
Standard availability	2H 2004	By end 2005
Spectrum	<11 GHz, 10-66 GHz (licensed and unl.)	< 6 GHz (licensed & unl.)
LOS / NLOS	LOS/NLOS	NLOS
Max Data rate (PHY)	Up to 75 Mbit/s in 20 MHz channels	Up to 15 Mbit/s in 5 MHz channels
Typical throughput	8-20 Mbps in 3,5-7 MHz	2-10 Mbps (estimated)
Modulation	OFDM 256 tones, adaptive	S-OFDMA up to 2048 tones, adaptive
Mobility	Fixed or nomadic	Mobile (Handover – up to 120 Km/h)
Channels	Scalable from 1.5 to 20 MHz	Scalable from 1.5 to 14 MHz
Max Cell radius	1-2Km (IND), 4-10Km (NLOS), 50Km (LOS)	2 - 5 km
QoS	Yes, 4 classes	Yes, 4 classes



Using an external antenna and a 7MHz FDD channel at 3.5 GHz, an 11 Mbit/s average throughput per sector is estimated. In NLOS environment the throughput decreases to 8 Mbit/s.

Intel's 802.16x ST Chipset Roadmap



Source: Intel, 2005

MobileFi Technology

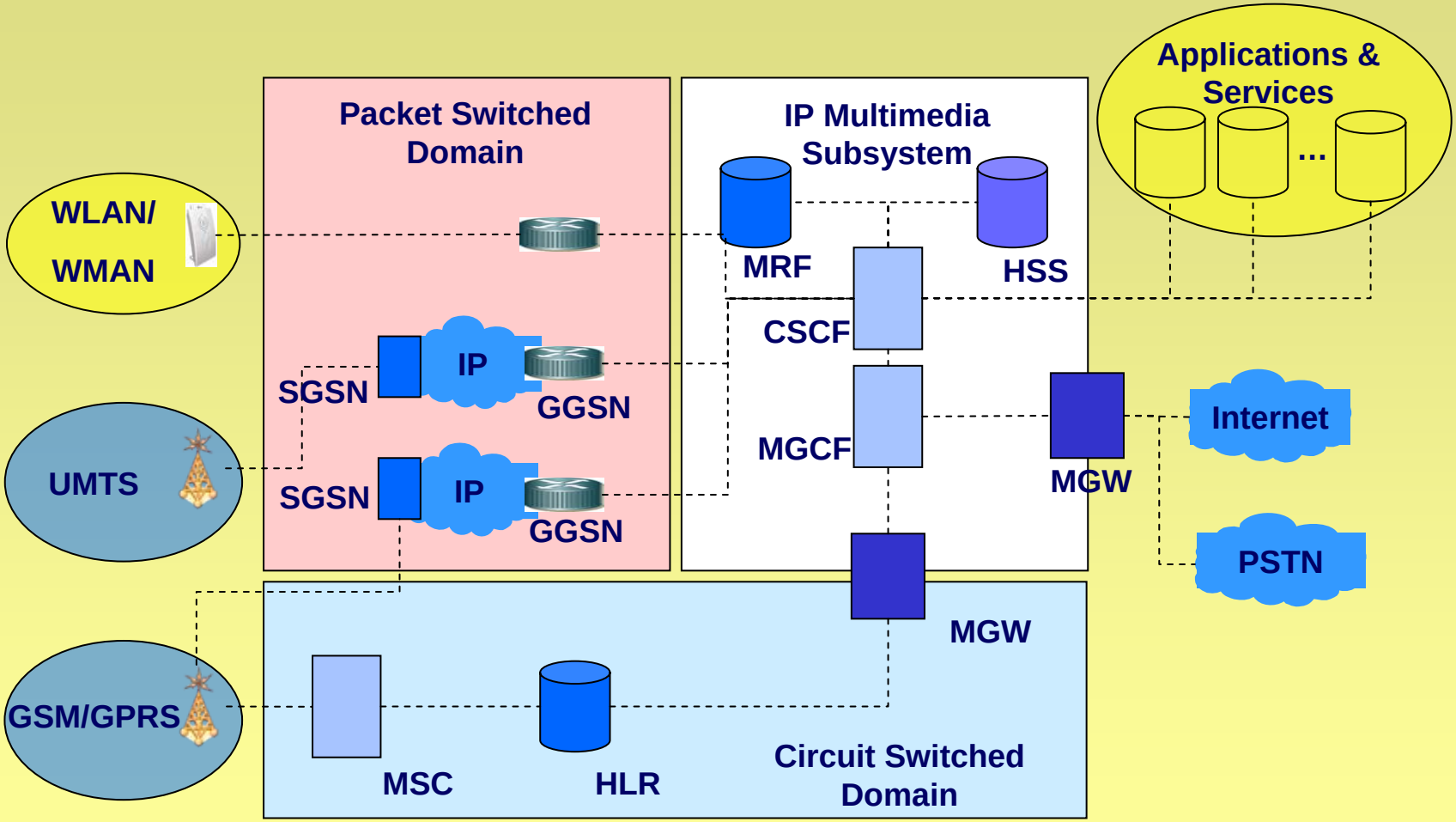
- **Flash-OFDM (Fast Low latency Access with Seamless Handoff-OFDM): custom technology developed by Flarion (Flarion acquisition by Qualcomm in progress) pushed to be standardised within Working Group IEEE 802.20 (MobileFi)**
- **OFDM modulation**
- **Frequency from 400 MHz to 3,5 GHz**
- **Up to more than 250km/h (300?)**
- **Interesting deployments in the 450MHz band**
  - **Good propagation: better coverage**
  - **1.25 MHz channels, max downlink throughput: 3.2Mbit/s (typical 1-2Mbit/s)**
  - **Analog cellular network licenses**

Licensed band - 450 MHz

Parameter (Per Sector), N=1	FLASH-OFDM®
Channel size	1.25 MHz paired FDD
Airlink	Fast Hopping OFDM
Network	Packet Switched
IP Friendliness	All IP
Peak DL Data Rate	3.2Mbps
Peak UL Data Rate	900kbps
Average DL Date Rate	1.0Mbps
Average UL Data Rate	300kbps – 500kbps
Average Latency	50ms
VoIP Calls	31
Sleep to On Transmission Time	~300ms
Schedulable Users	126
Mobility	250km/hr
Handoff	Seamless Voice & Data

Rural Outdoor	25km
Suburban Outdoor	10km

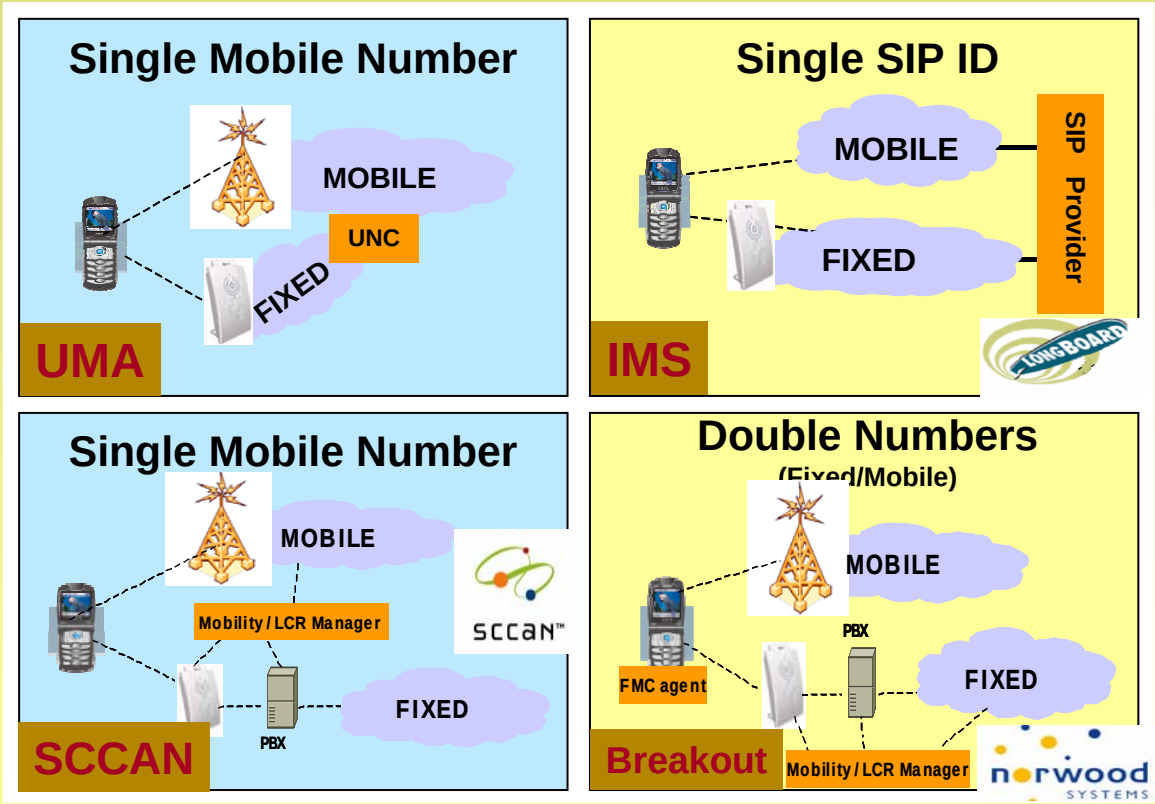
IMS Architecture: WiFi/WiMAX Integration



IMS = IP Multimedia Subsystem

Fixed to Mobile Convergence Models

based on Dual Mode Terminals (Wi-Fi-WiMAX/2G-3G)



UMA (Unlicensed Mobile Access)
SCCAN (Seamless Converged Communication Across Networks)

Source: ICT Consulting, 2004

Summary

- Peer-to-Peer Telephony is a Threat to Telco's Business?
  - Cannot “scale” without Quality of Service provisioning by Telco's/ISPs
  - It Accelerates the Voice Revenues Decline
  - It urges Telco's to accelerate provision of Full IP Platform & Convergent Services (Fixed & Mobile)

- Broadband Wireless Technology (WiFi, WiMAX & MobileFi), is a Threat to Telco's Business?
  - Can be used to create competing Full Mobility IP Wireless Networks
  - Telco's are urged to accelerate integration of Broadband Wireless Access in their Fixed & Mobile 2G/3G Infrastructures
  - Incorporation of heterogeneous Wireless Access Networks offers new attractive Convergent Service opportunities to Telco's