

WiMAX and Cellular: Competitive or Complementary?

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Senza Fili Consulting

experience in wireless data



Technology focus

- Wireless data technologies and services:
- Wi-Fi, WiMAX, proprietary BWA, cellular (GSM, WCDMA, EV-DO, HSDPA) technologies
 - Data and VoIP services

Approach

- Provide a bridge between technologies and services, assisting vendors and service providers
- Quantitative analysis, with an international perspective
- Carrier, enterprise and residential markets

Services

- Business plans and financial modeling
- Business development and strategy
- Market research and forecast
- Due diligence
- Publications and training

Jumping ahead to the conclusions

- 3G and WiMAX will compete, but also have to coexist
- The technology roadmap for cellular and WiMAX is converging fast towards OFDMA, IP core, IMS
 - Will we be able to keep cellular and WiMAX apart?
- 3G and WiMAX differ in their approach to wireless data:
 - 3G is a voice technology moving towards data
 - WiMAX is a data technology moving towards mobility
- Both 3G and WiMAX meet the requirements for wireless broadband
- Performance differences will not decide which technology is adopted and where
- The challenge for service providers is to understand which technology is better suited to their needs

WiMAX versus 3G (or Wi-Fi): Competition or coexistence?

- Competition for
 - Service provider investment
 - Subscribers' traffic
- Coexistence within
 - Infrastructure
 - Devices

- Service providers have to integrate multiple edge technologies
- Subscribers will have devices with multiple wireless interfaces
- Adoption will grow, but use will still be split among technologies
- Overall mobile data ARPU unlikely to increase in line with use

- Best way to increase wireless traffic is fixed-to-wireless substitution
 - Cellular: UMA, GSM-over-IP
 - WiMAX: personal broadband

**WiMAX, 3G and Wi-Fi will compete,
but to success they have to peacefully coexist**

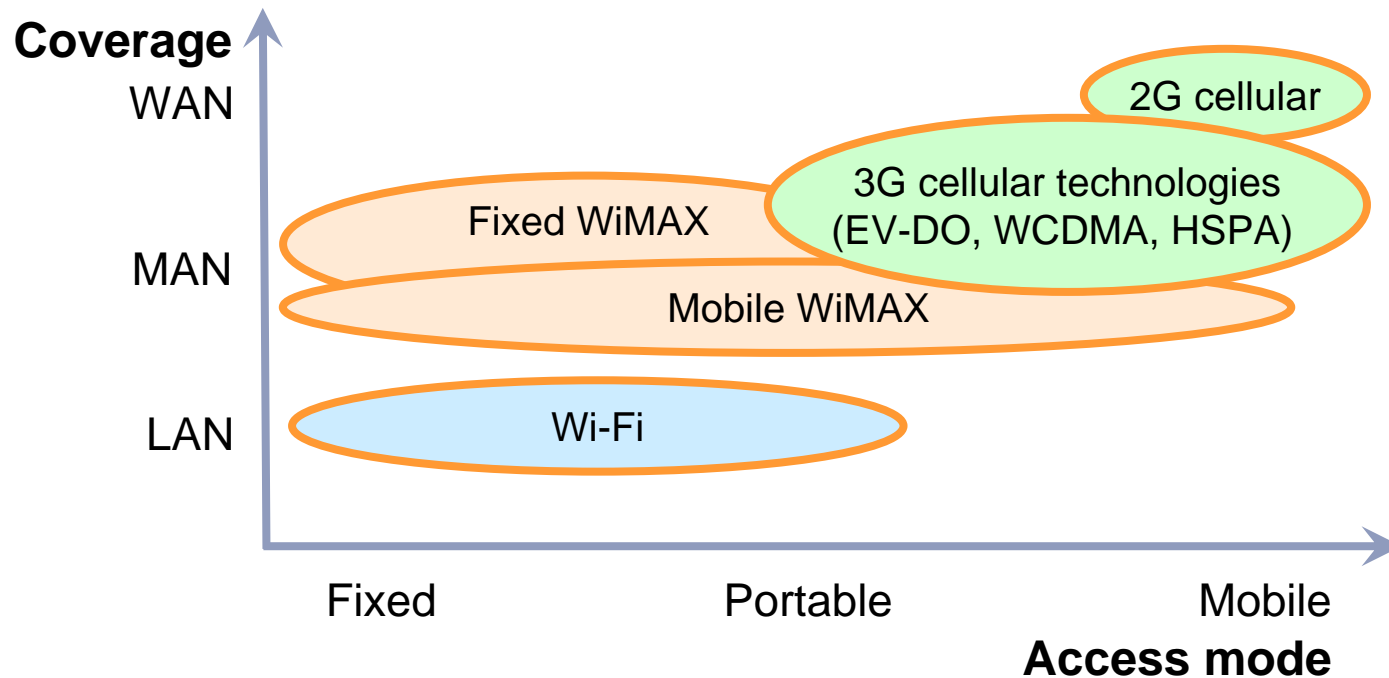
The proposition to a mobile operator

Why WiMAX

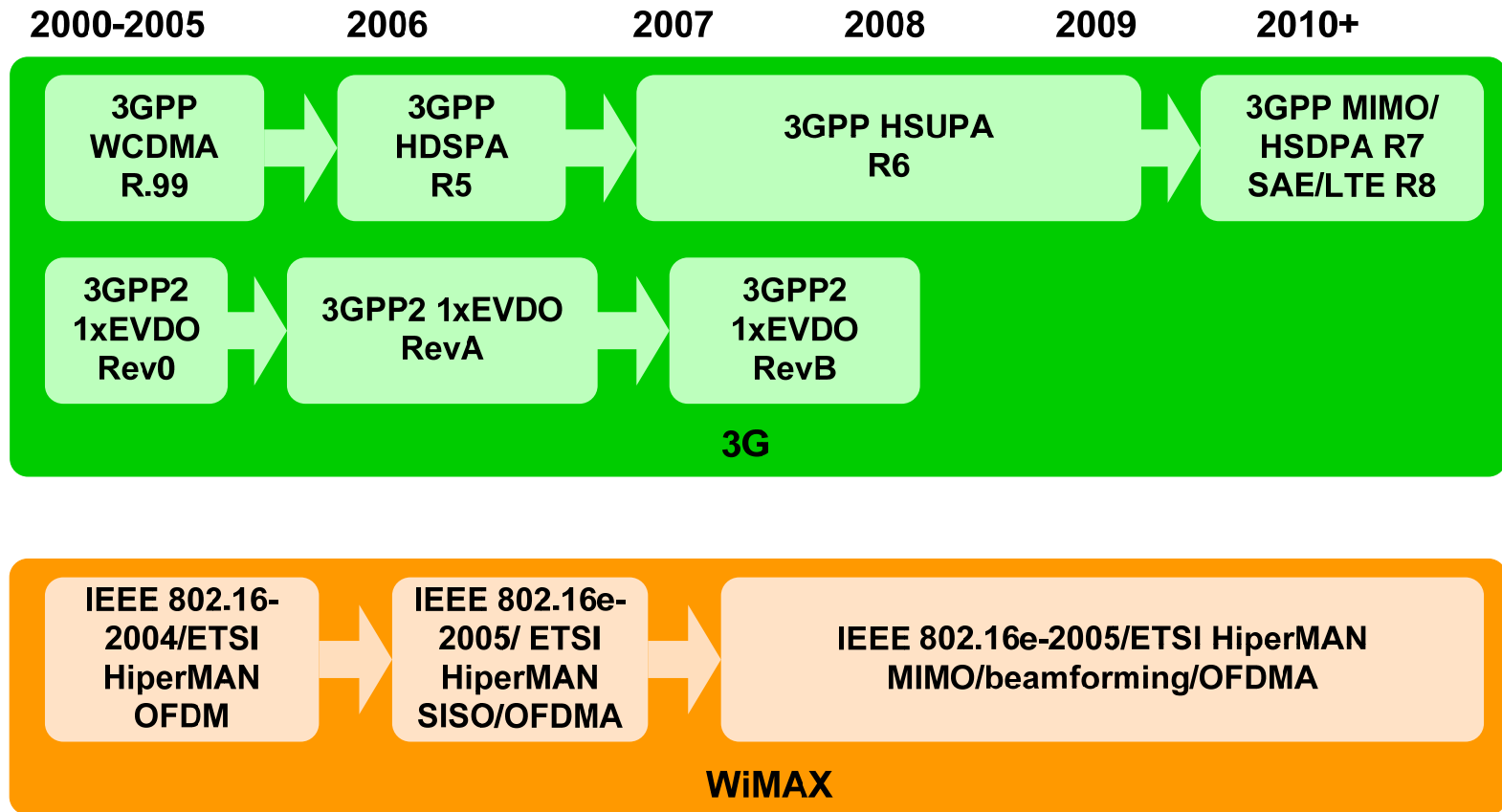
- Fixed and mobile data access
- Efficient use of spectrum
- Support for VoIP and other real-time applications with QoS
- IP core network
- Attractive IPR
- Cost-effective infrastructure

Why 3G?

- Voice and data services
- Incumbent technology
- Specifications developed for mobile operators
- End-to-end architecture defined
- Extensive deployed infrastructure
- Mandated by regulation



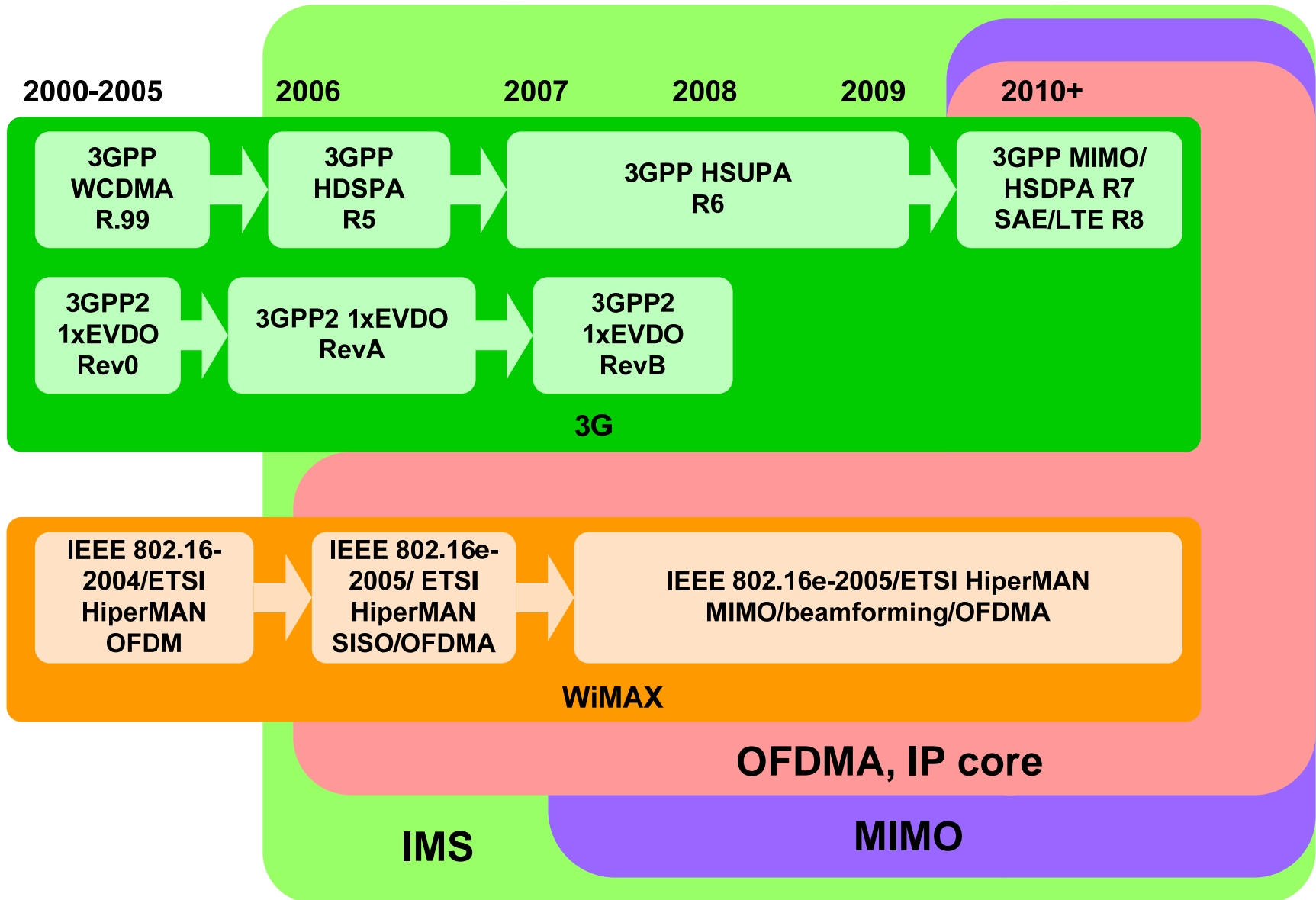
Mobile WiMAX is a couple of years ahead of LTE



Source: WiMAX Forum, Senza Fili Consulting

LTE is the technology that is closer to WiMAX but direct comparison is yet premature

3G and WiMAX are converging towards OFDMA, IMS and an IP core



A different approach to wireless broadband

3G

- Voice → Data
- SMS, ringtones → Streaming, music downloads, gaming
- Handset → Laptop
- Developed market → Developing markets
- Circuit switched → Packet switched
Legacy core → IP
- Nationwide coverage → High capacity in dense area and indoors



Extension of mobile phone service
Mobility and ubiquity are the main drivers to adoption

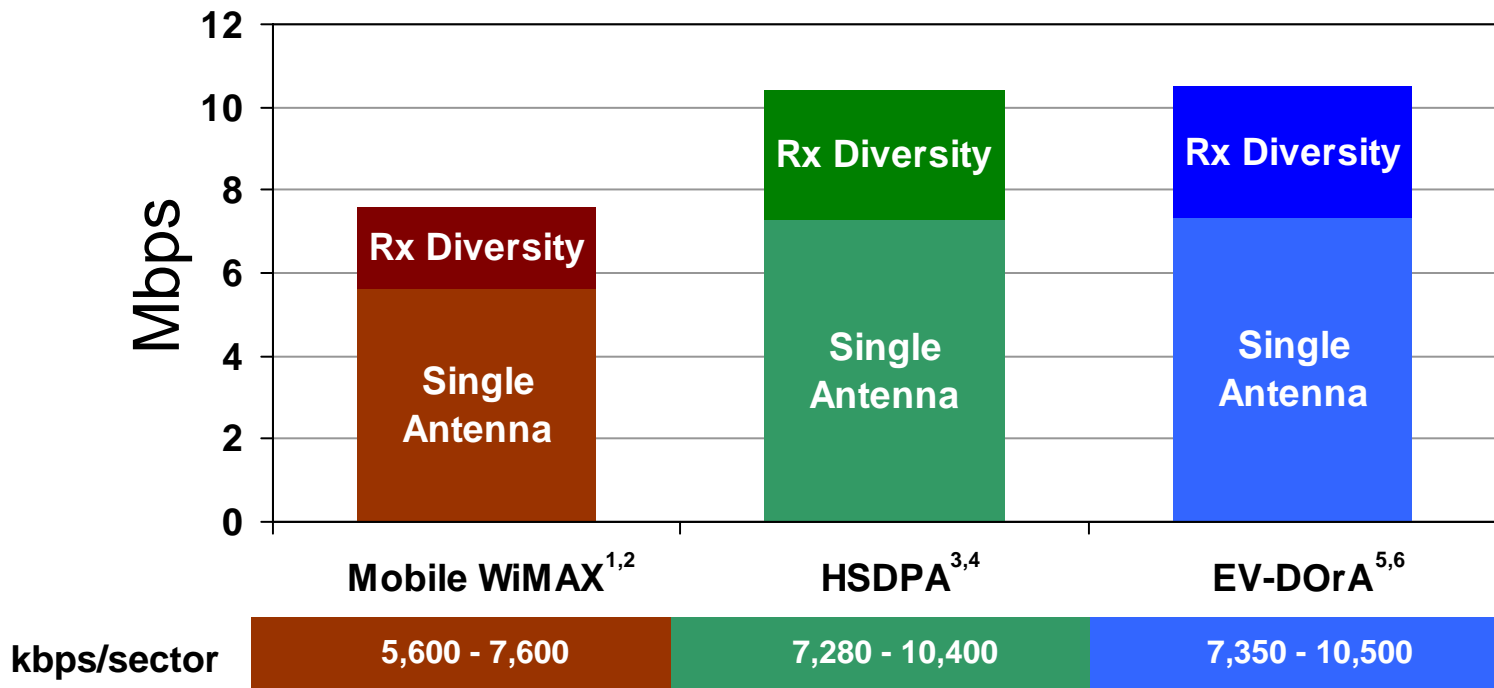
WiMAX

- Fixed data → Mobile Data
- Email, web browsing → VPN, streaming, content downloading, gaming
- Laptop → Handset, CE devices
- Developing markets → Developed market
- Packet Switched
- IP
- Small high-capacity deployments → City wide deployments



Best suited to subscribers with high bandwidth devices and mobile lifestyles

WiMAX and 3G performance compared: the Qualcomm view



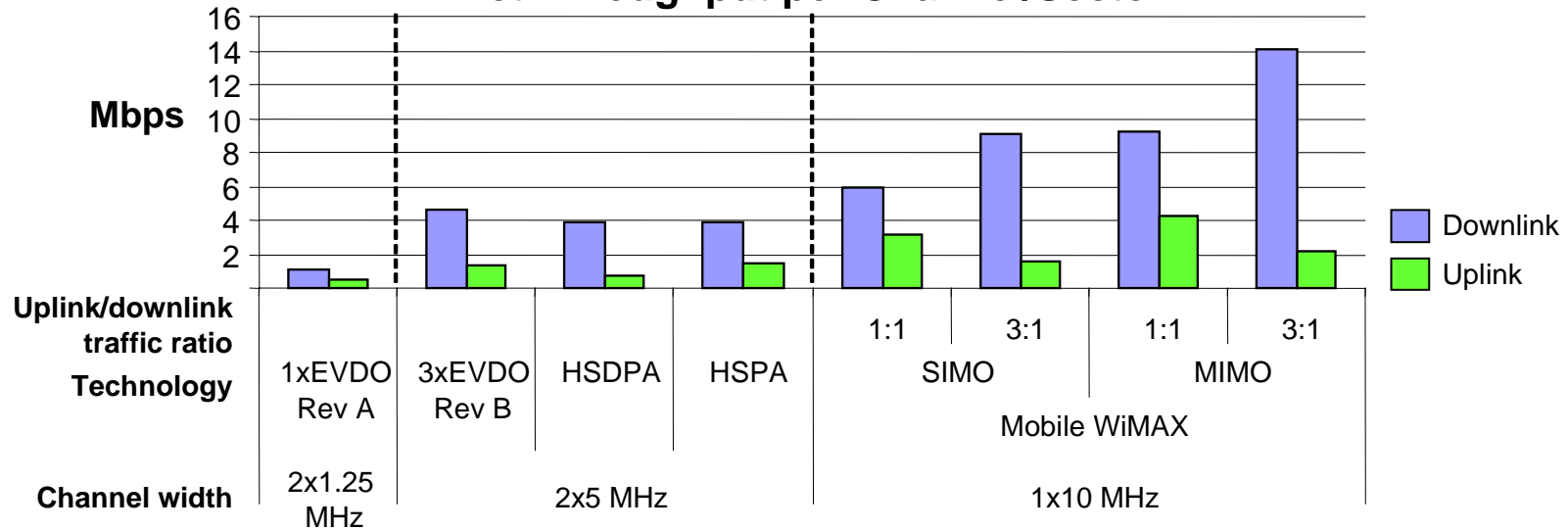
Simulation assumptions assume 100% loading of data traffic:

- 1 Full buffer; ITU channel models: *pedA 3km/h 30%, pedB 10km/h 30%, vehA 30km/ 20%, pedA 120km/h 10%, Rician 10%*
- 2 No Guard band assumed, frequency reuse of 1
- 3 Full buffer; ITU channel models: *pedA 3km/h 30%, pedB 10km/h 30%, vehA 30km/ 20%, pedA 120km/h 10%, Rician 10%,*
- 4 Perfect Linear MMSE equalizer assumed, back off 0.75dB
- 5 Full buffer; ITU channel models: *pedA 3km/h 30%, pedB 10km/h 30%, vehA 30km/ 20%, pedA 120km/h 10%, Rician 10%*
- 6 Equalizer gain simulated; 1.25MHz carriers, 7 in 10MHz

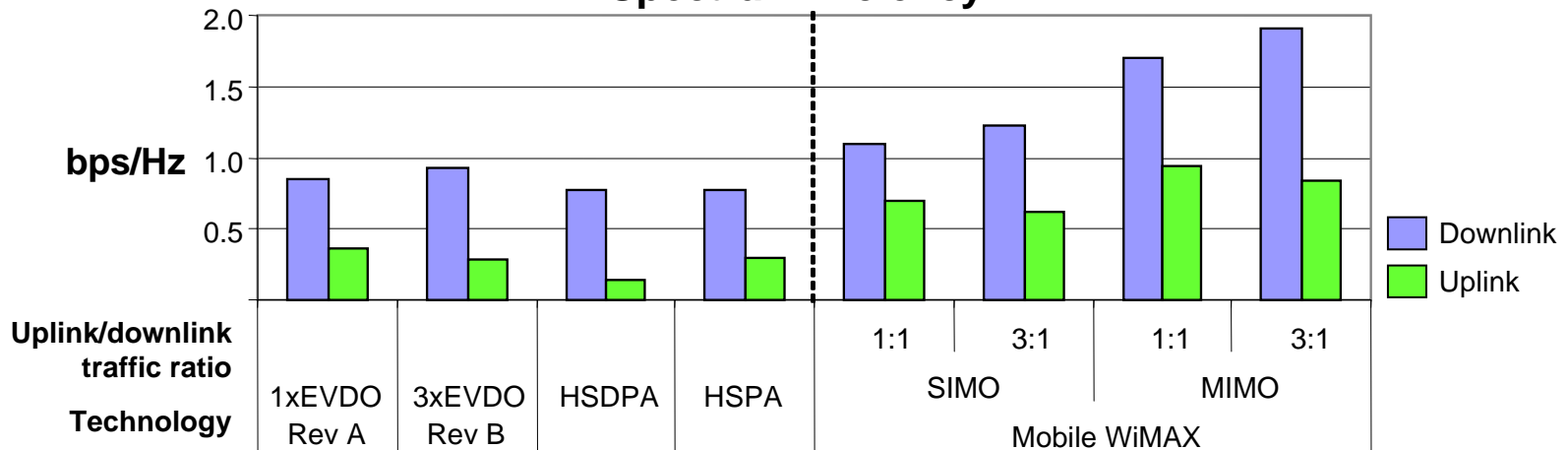
Source: Qualcomm

WiMAX and 3G performance compared: the WiMAX Forum view

Net Throughput per Channel/Sector



Spectral Efficiency



Source: WiMAX Forum

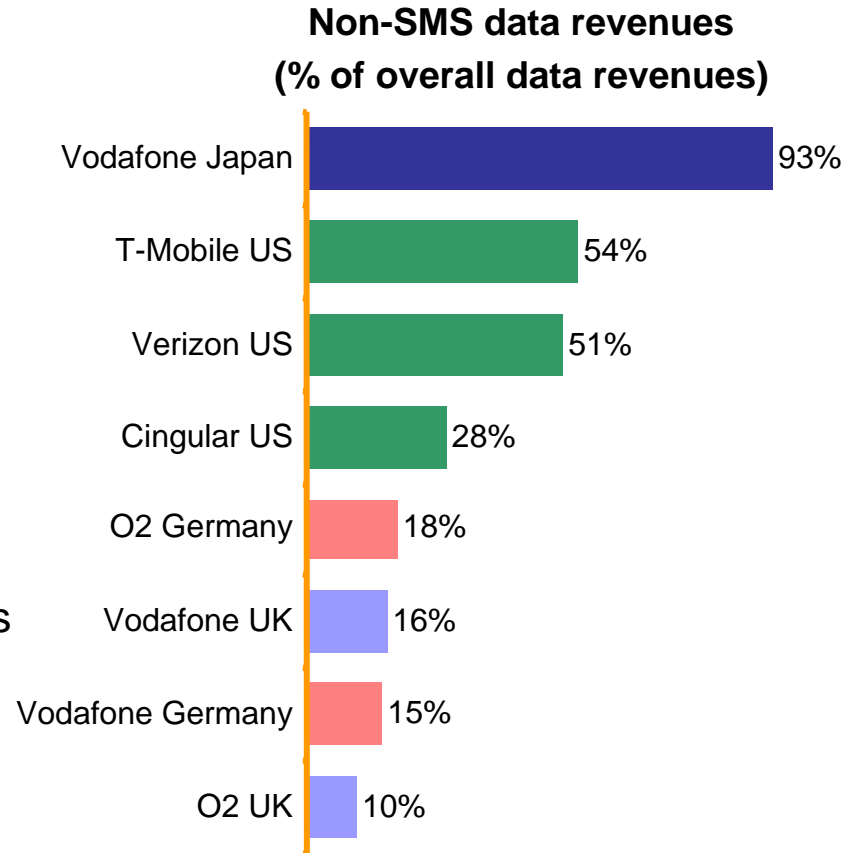
Who is right?

- In a simulation, it all depends on the assumptions
 - Assumptions depend on target market, services, environment
 - (and possibly some bias)
- Real deployments will give us a better insight
 - Still it will be unlikely that one technology will always perform better
- In the short term, WiMAX appears to enjoy some performance advantages being ahead of LTE
- As 3G and WiMAX converge towards OFDMA, MIMO, and wider channels the performance gap is likely to narrow

**In the long term, performance is not the key differentiator
between 3G and WiMAX**

The challenges to 3G data services

- Most data revenues from SMS in many markets
- Many phone apps do not really need broadband
- Slower than expected 3G adoption
- Very few laptop users
 - Verizon: 200-400K
 - Vodafone Germany: 140K
 - Most operators do not even quote numbers
- Declining usage of MMS in some markets
- Little interest in video calls
- Subscribers find it difficult to use the services
- Low 3G network utilization over the next few years



Source: Senza Fili Consulting

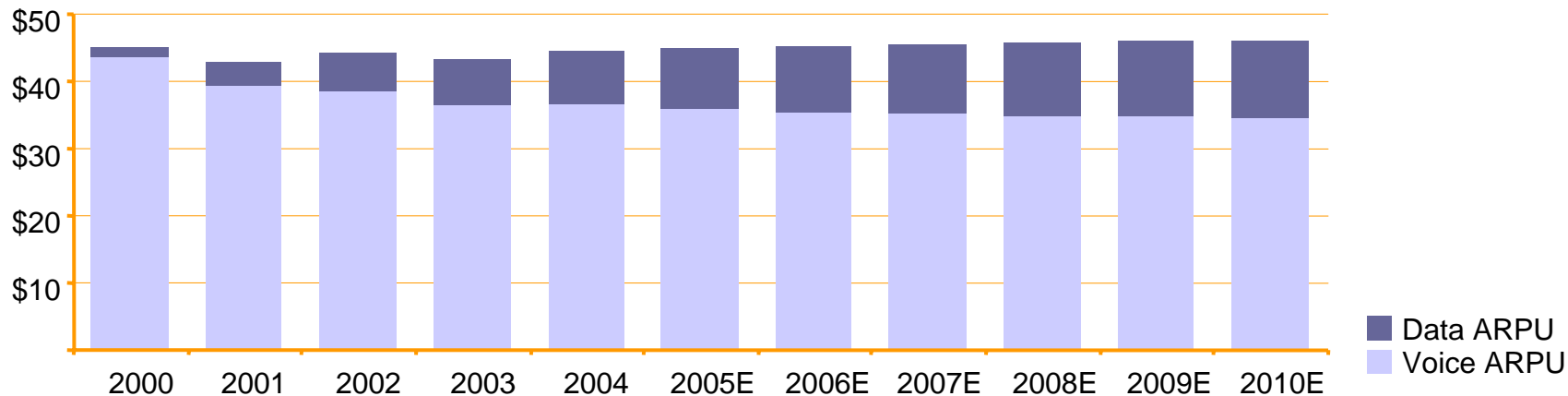
Marketing and pricing strategy have limited 3G data adoption

- Mobile operators have tried to market heavily content and applications through their portals
 - Subscribers are used to the freedom of the Internet and find it difficult to adjust to the walled garden approach
- Most successful applications not planned by mobile operators
 - SMS
 - Ring tones
- Data and voice compete for the same resources
 - Price for voice traffic is much higher than data, so voice has priority
 - Lowering data prices may create congestion and endanger voice revenues
- Laptop market not aggressively targeted
 - Few indoor laptop users can create network congestion
 - Prices are perceived to be too high

**Would mobile operator develop a more effective
data market strategy for WiMAX?**

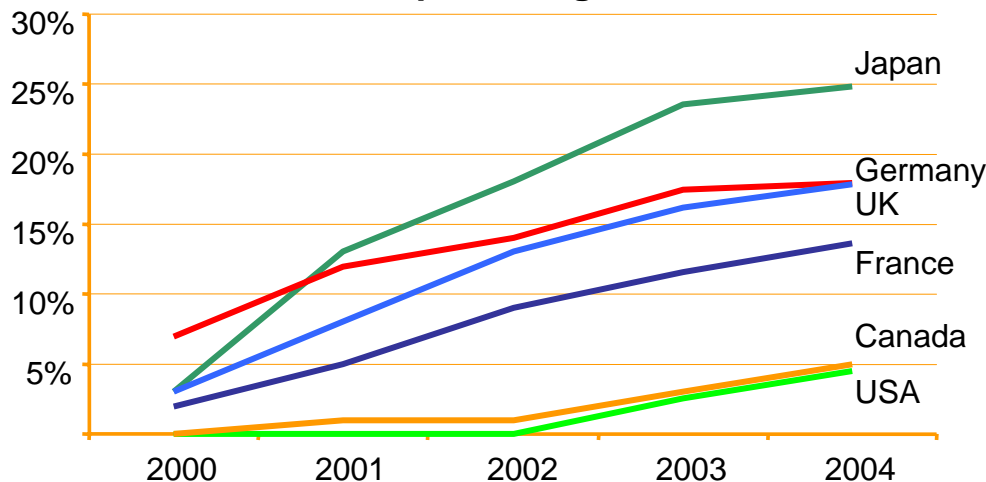
Despite the fact the mobile operators need higher data revenues to boost their voice ARPU

Voice and data ARPU in the UK



Source: Senza Fili Consulting

Data as a percentage of ARPU

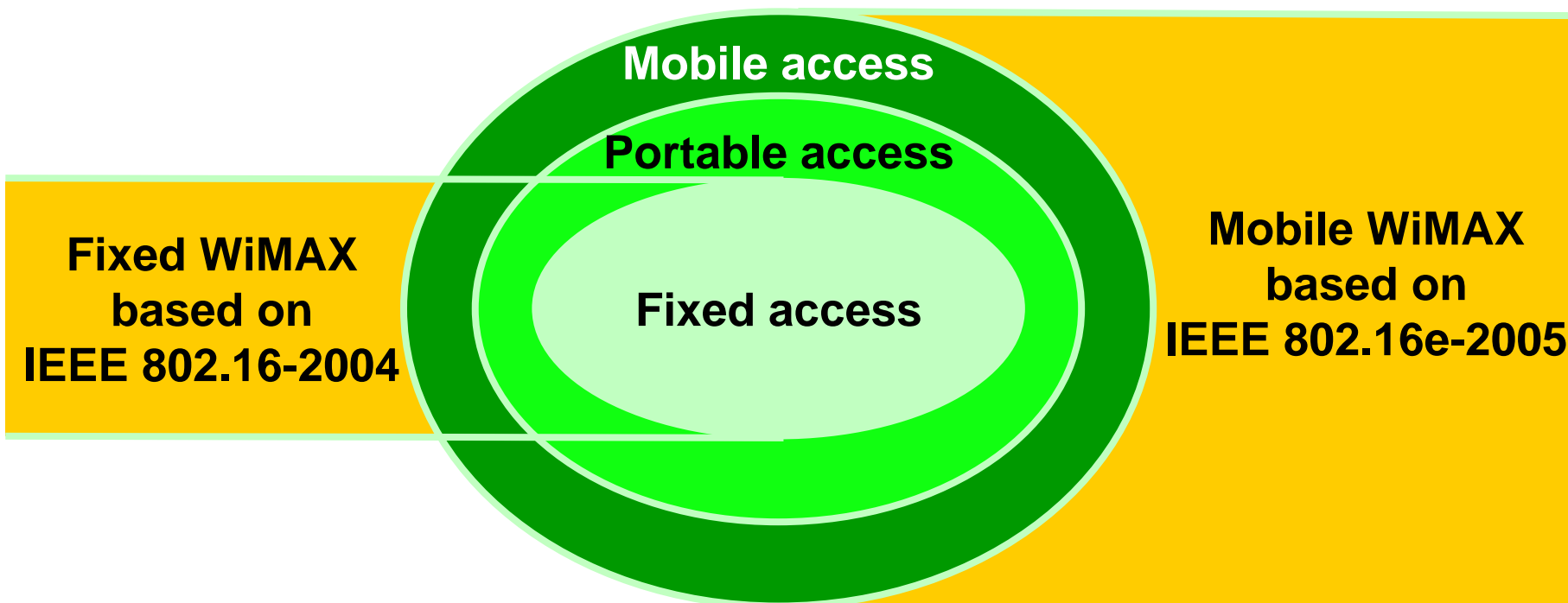


Source: Senza Fili Consulting

The WiMAX timeline

	Fixed access	Portability	Full mobility	
Dominating standard	IEEE 802.16-2004	IEEE 802.16e-2005		
Services	Alternative to T1, DSL, cable, satellite, and other BWA technologies	Plus: VoIP, QoS-based applications	Plus: mobile access with handoffs	
Subscriber unit form factor	Outdoor/Indoor CPE	Plus: PCMCIA card	Plus: Client built-in	
Subscriber unit price	\$300		Plus: PDA, smartphone	
Market segment	Business and residential fixed access	Plus: portable access	Plus: mobile access	
Geography	Emerging markets, underserved areas	Plus: competitive areas	Plus: dense urban areas	
	2006	2007	2008	
				2009

Mobile WiMAX is well suited to support personal broadband

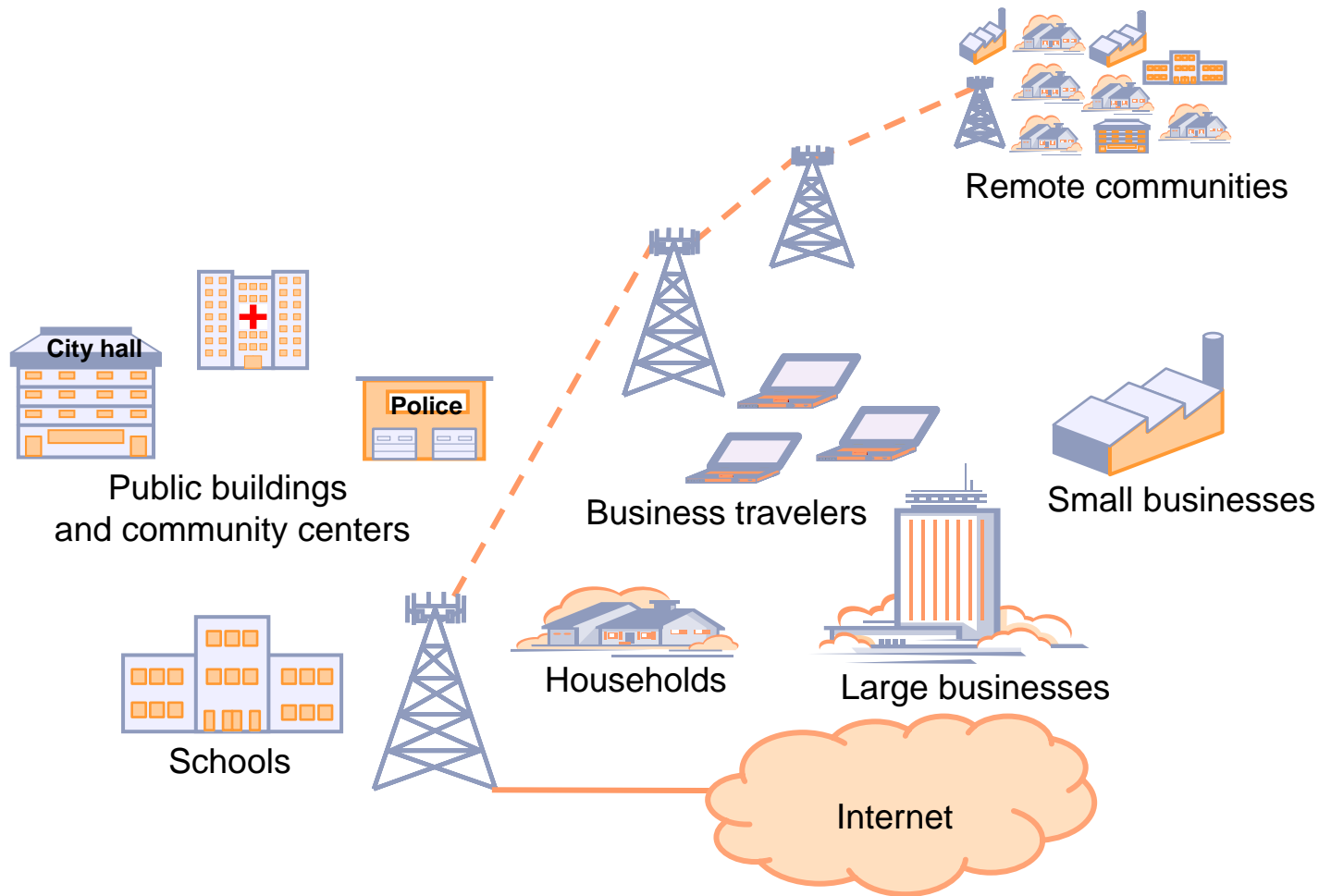


Personal broadband requires a wireless interface that supports fixed, portable and mobile access

Fixed or mobile WiMAX?

	Fixed WiMAX	Mobile WiMAX
Standard	802.16-2004	802.16e-2005
Access	Fixed	Fixed, portable and mobile
Modulation and duplexing	OFDM TDD, FDD	SOFDMA TDD, possibly FDD
Handoffs	No	Yes
Service providers targeted	DSL and cable modem service providers, wireless and wired ISPs	Mobile operators, DSL and cable modem service providers, wireless and wired ISPs
Subscriber unit	Outdoor or indoor CPE, eventually PCMCIA card	Indoor CPE, PCMCIA card, mini-card built in laptops, mobile devices, phones
Spectrum bands	3.5 GHz, 5.8 GHz	2.3-2.4 GHz, 2.5-2.7 GHz, 3.3-3.4 GHz, 3.4-3.8 GHz
Certified products	January 2006	1Q2007 (Expected)

A single WiMAX network can support business, residential, and public services



The same infrastructure can support both fixed and mobile access

With WiMAX the distinction between fixed and mobile is dissolving

Single technology supports both fixed and mobile access

- Wireless broadband becomes a personal broadband service
- Substitution is likely to take place among highly mobile subscribers

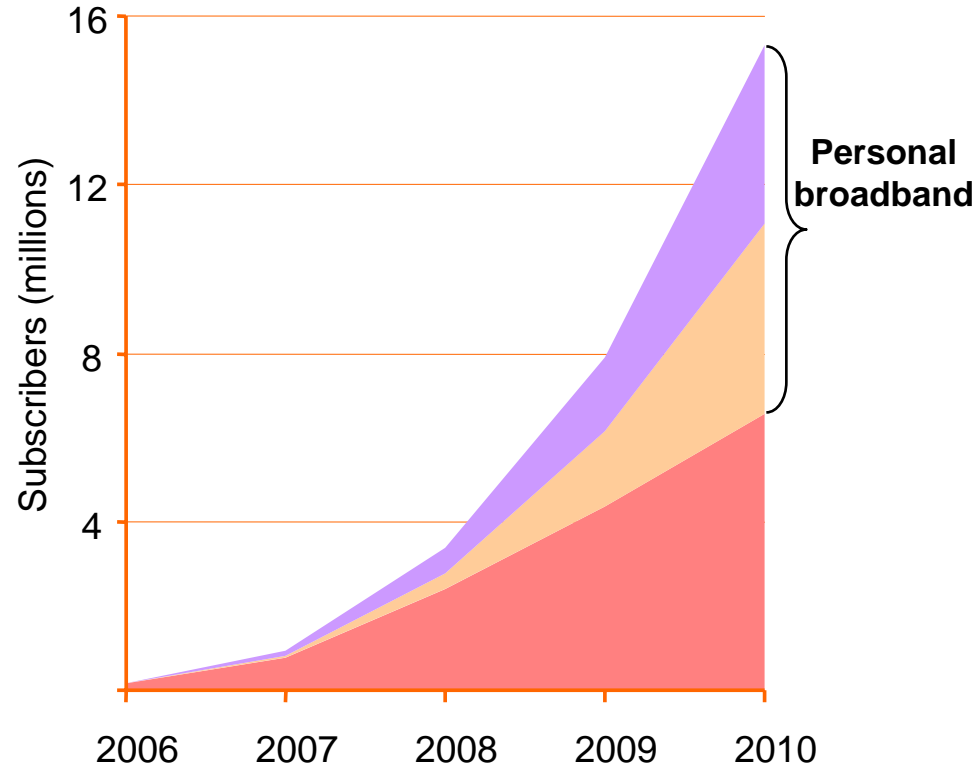
Lower barriers to entry for fixed operators that want to offer mobile services

- Extension to mobility improves business case greatly
- Marginal cost to offer mobile access is very low
- No business case for data-only mobile networks

New source of competition for mobile operators

- Mobile operators may decide to add a fixed + mobile plan on a WiMAX network

WiMAX subscribers

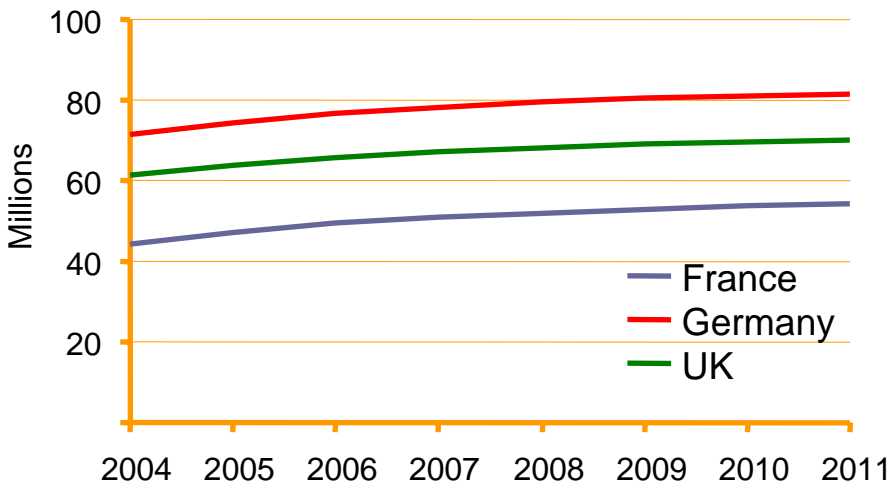


- Mobile WiMAX (802.16e) for mobile access
- Mobile WiMAX (802.16e) for fixed access
- Fixed WiMAX (802.16-2004)

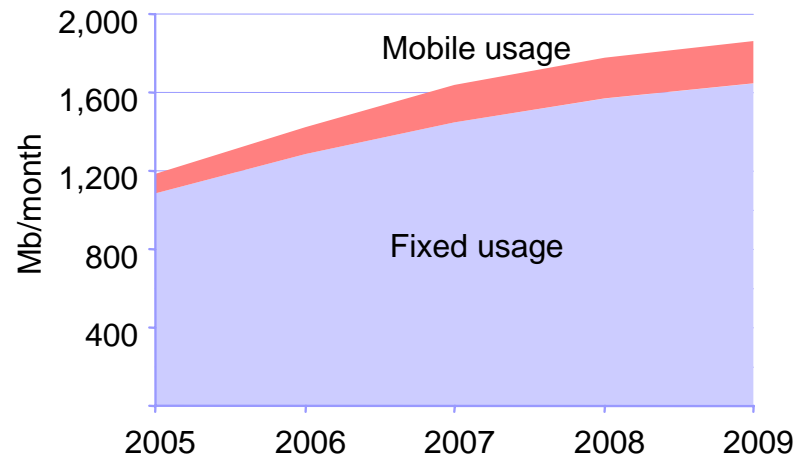
Source: Senza Fili Consulting, "Fixed or mobile WiMAX? Forecasts and assessment for the transition from 802.16-2004 to 802.16e WiMAX"

Personal broadband has a clear appeal in developed markets

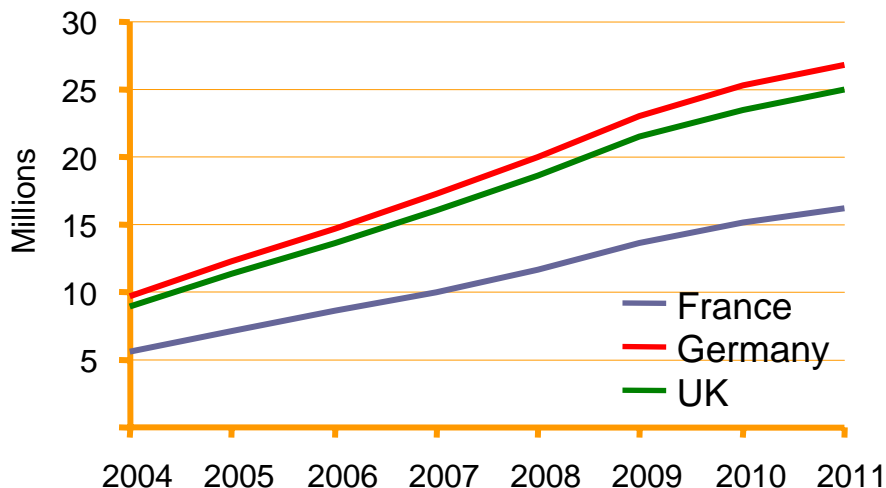
Cellular subscribers



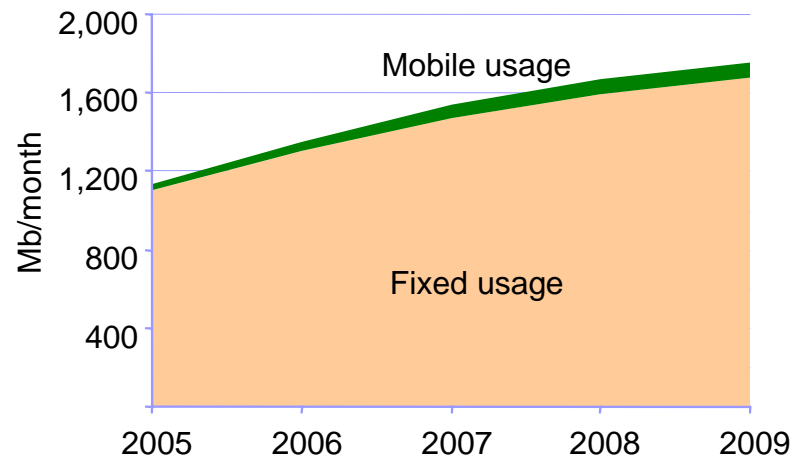
Business Users - MB/month



Laptops in use



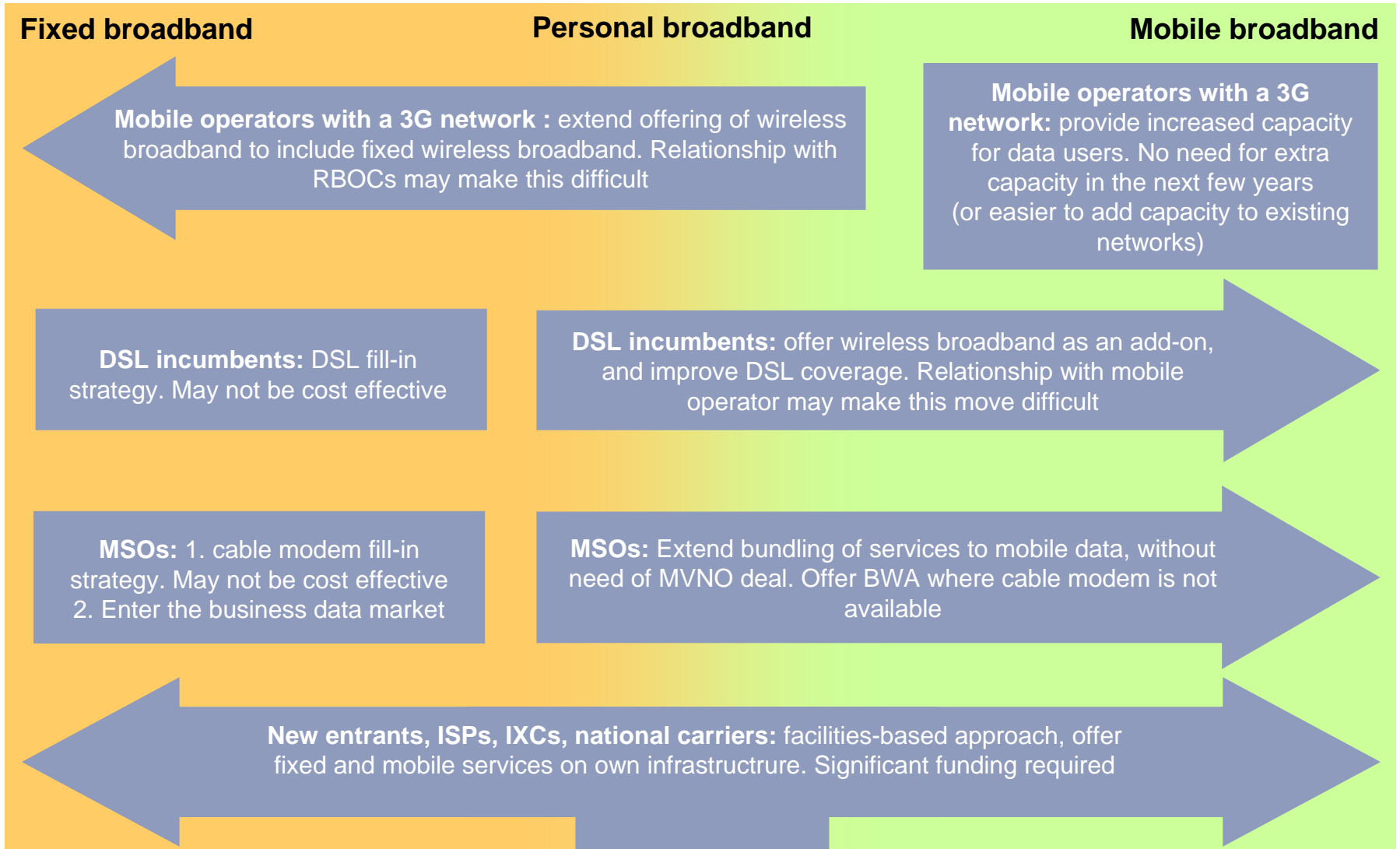
Residential Users - MB/month



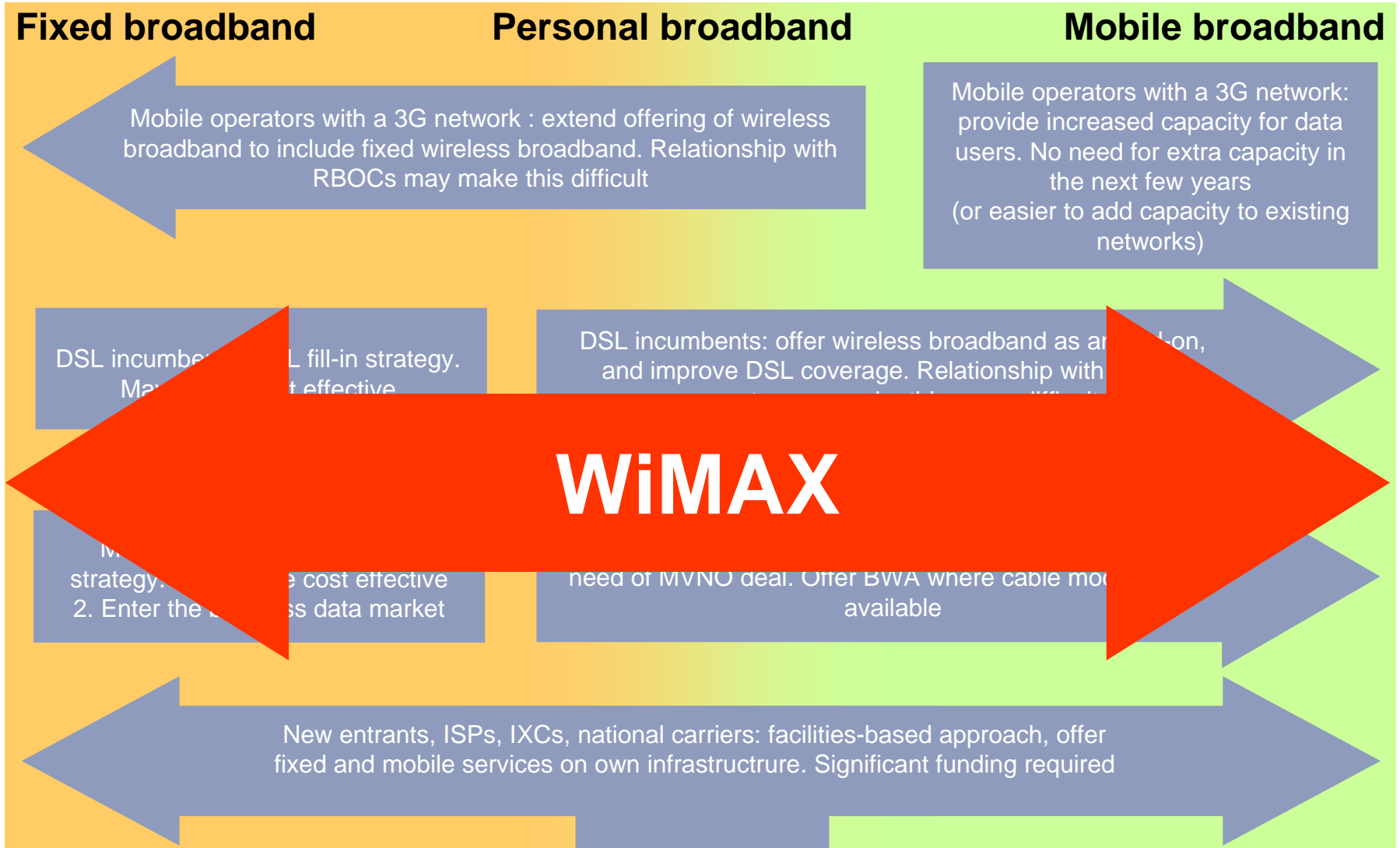
Source: Senza Fili Consulting

Source: BWCS, Senza Fili Consulting

Who will deploy WiMAX?



WiMAX enables service providers to expand or improve their service portfolio



How to make money with wireless broadband?

- Three models
 - The 3G operators' strategy: Use voice to fill capacity and get additional revenues
 - The Clearwire model (our assumption): Offer personal broadband (fixed and mobile) services
 - The Sprint model (our assumption): Move into personal broadband as an add-on service
- Two important contributions
 - Roaming with other providers, to get the needed footprint for mobility if a national network is not planned or possible
 - Focus on vertical applications, like safety, surveillance, health, education

**It is a tough business case, but it can be done
if service provider offers attractive service**

Concluding remarks

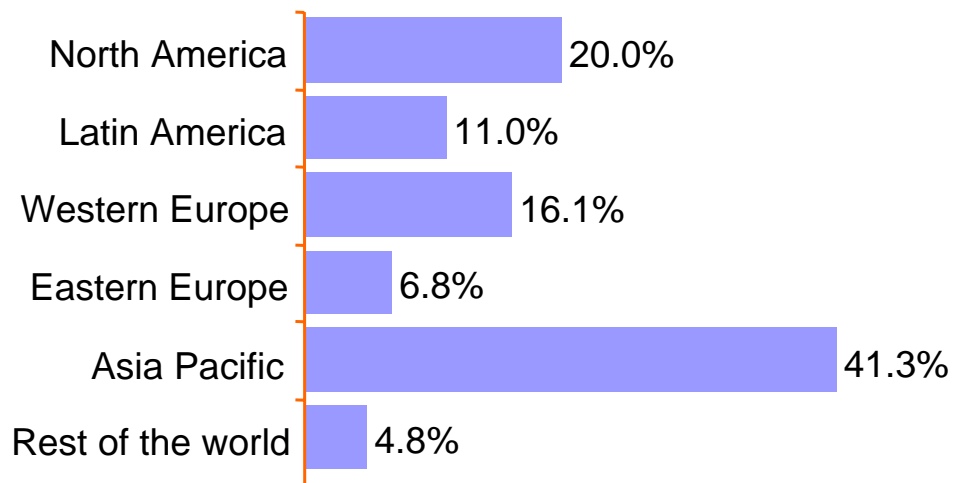
- 3G will stay, WiMAX will make personal broadband a reality
- WiMAX will capture a market different from 3G
 - Emerging markets will be at the forefront
 - 3G operators will not, for once, be first adopters
- Trend to cross the fixed-mobile divide
 - Mobile operators moving into fixed services
 - Fixed operators moving into mobile services
- Increased competition
 - Based on services offered, pricing, business models
 - Not based on technology

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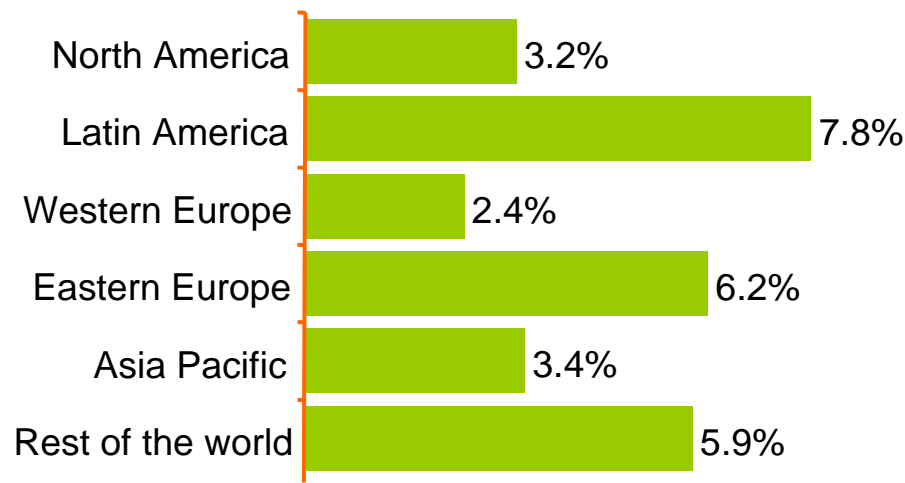
Backup slides

Emerging economies are the best WiMAX markets

Percentage of WiMAX global subscribers



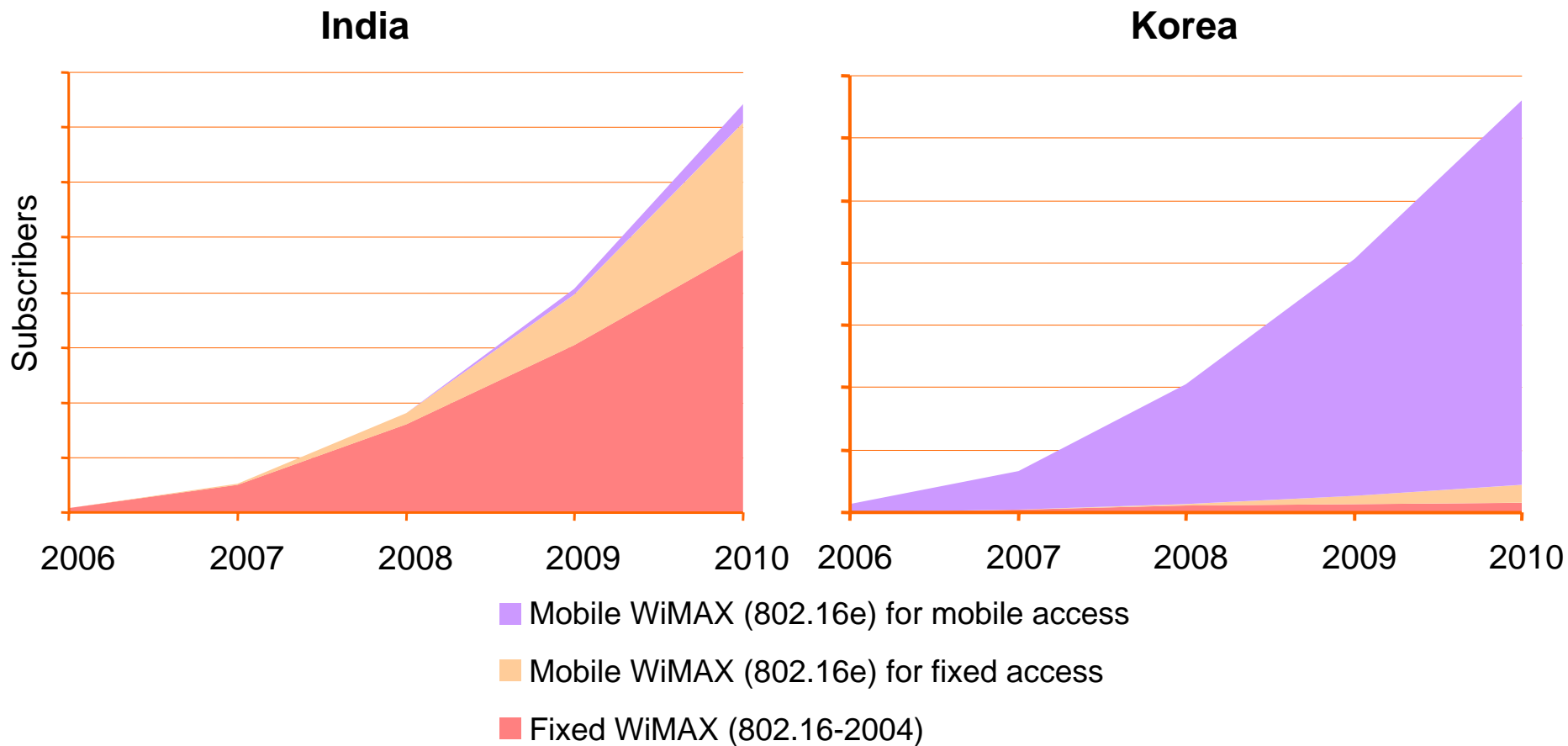
Percentage of WiMAX among broadband subscribers in the market



Source: Senza Fili Consulting, "Fixed or mobile WiMAX? Forecasts and assessment for the transition from 802.16-2004 to 802.16e WiMAX"

- Percentage of WiMAX global subscribers depends on population and broadband penetration
 - Large countries capture a large market share of worldwide subscriptions
- Ratio of WiMAX subscribers measures WiMAX penetration within a country
 - A high ratio indicates success of WiMAX within country

The dynamics of adoption change dramatically across developing and developed markets



Source: Senza Fili Consulting, "Fixed or mobile WiMAX? Forecasts and assessment for the transition from 802.16-2004 to 802.16e WiMAX"