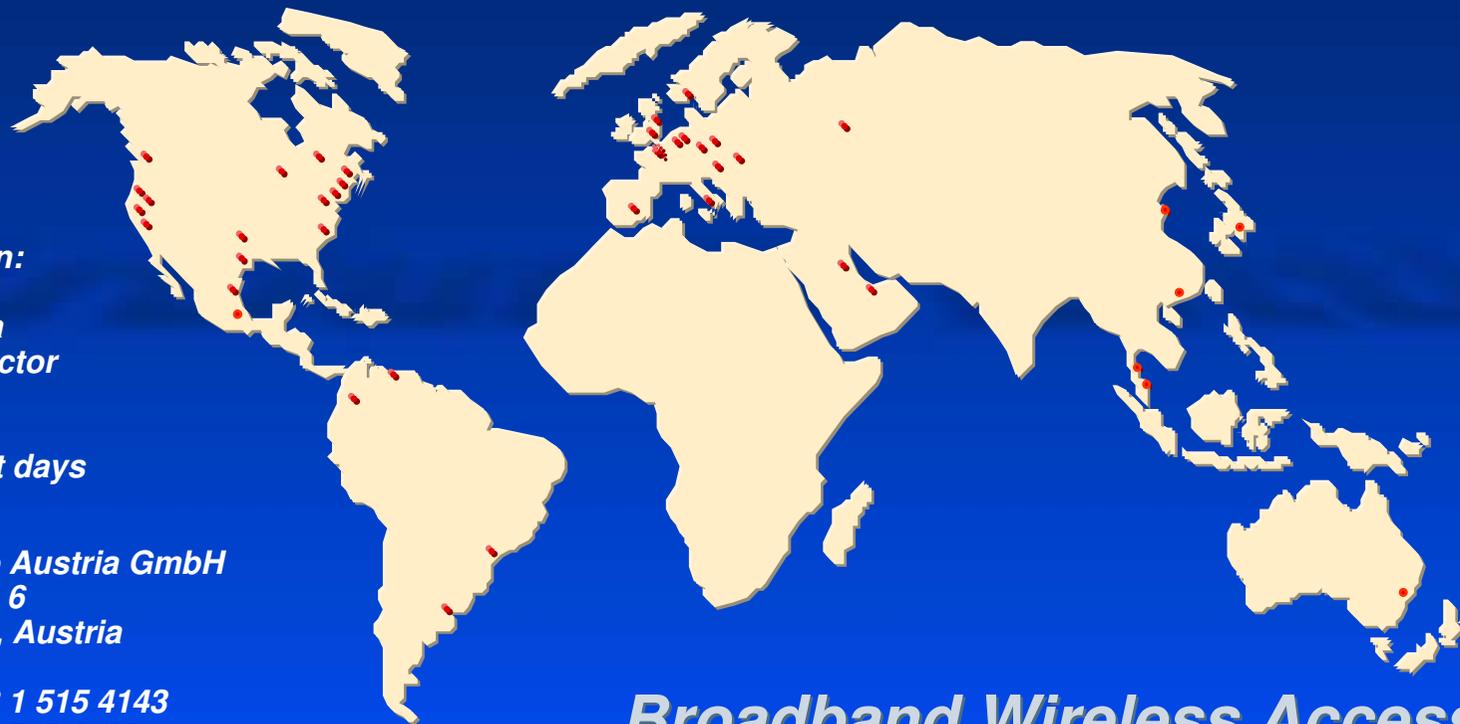# Arthur D Little

Contact Person:

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TP Convergent days

Arthur D. Little Austria GmbH
Kärntner Ring 6
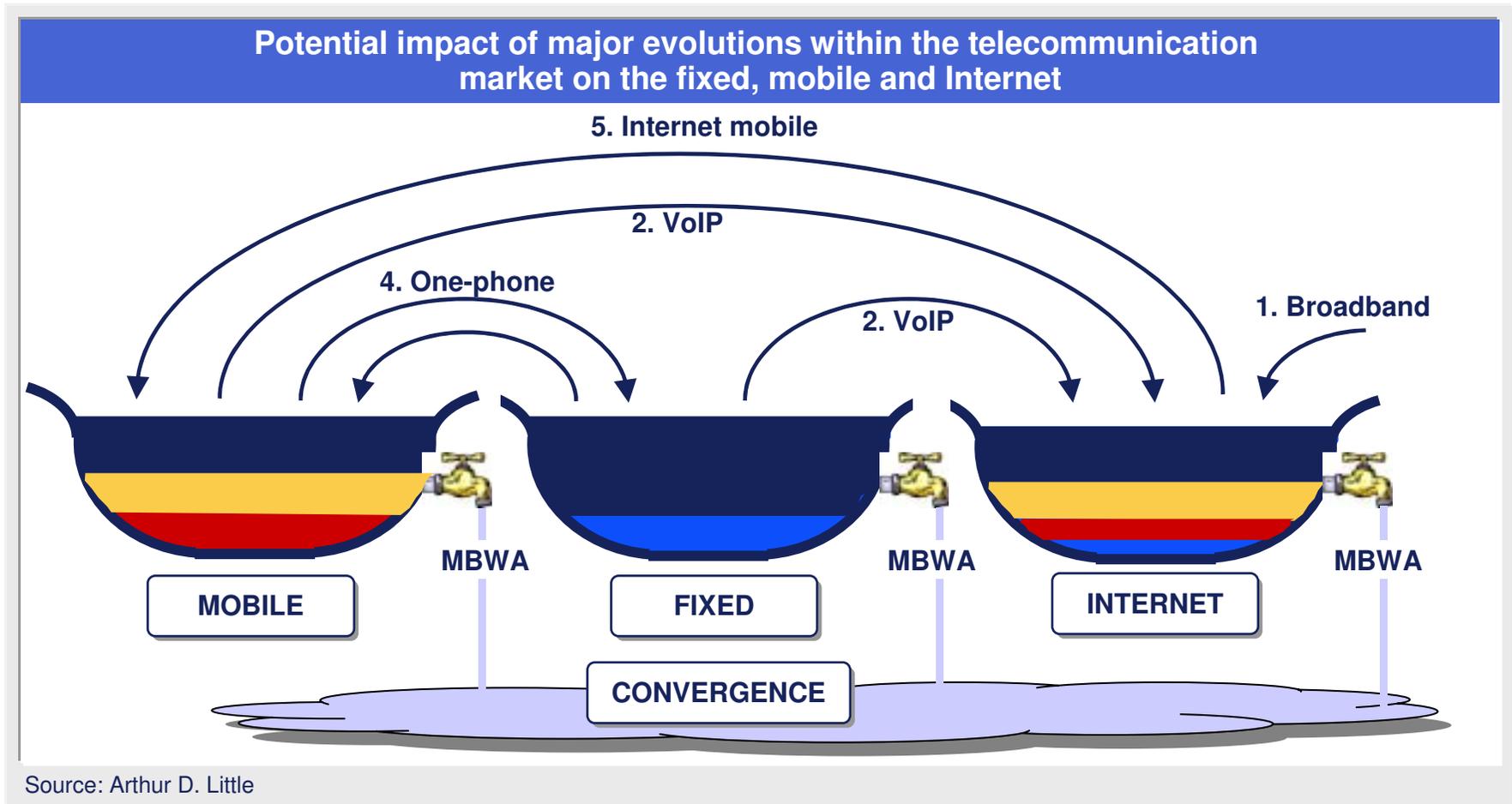**A-1015 Vienna, Austria**

Telephone +43 1 515 4143
Telefax: +43 1 515 4123
www.adl.com

**Broadband Wireless Access …**
… will Mobile dominate again?

Contents

Arthur D Little

The most significant changes in the current market balance will take place due to emerging MBWA technologies

Potential impact of major evolutions within the telecommunication market on the fixed, mobile and Internet

Source: Arthur D. Little

Mobile Broadband Wireless technologies are able to offer enhanced freedom to customers in terms of greater mobility at higher bandwidth (speed)
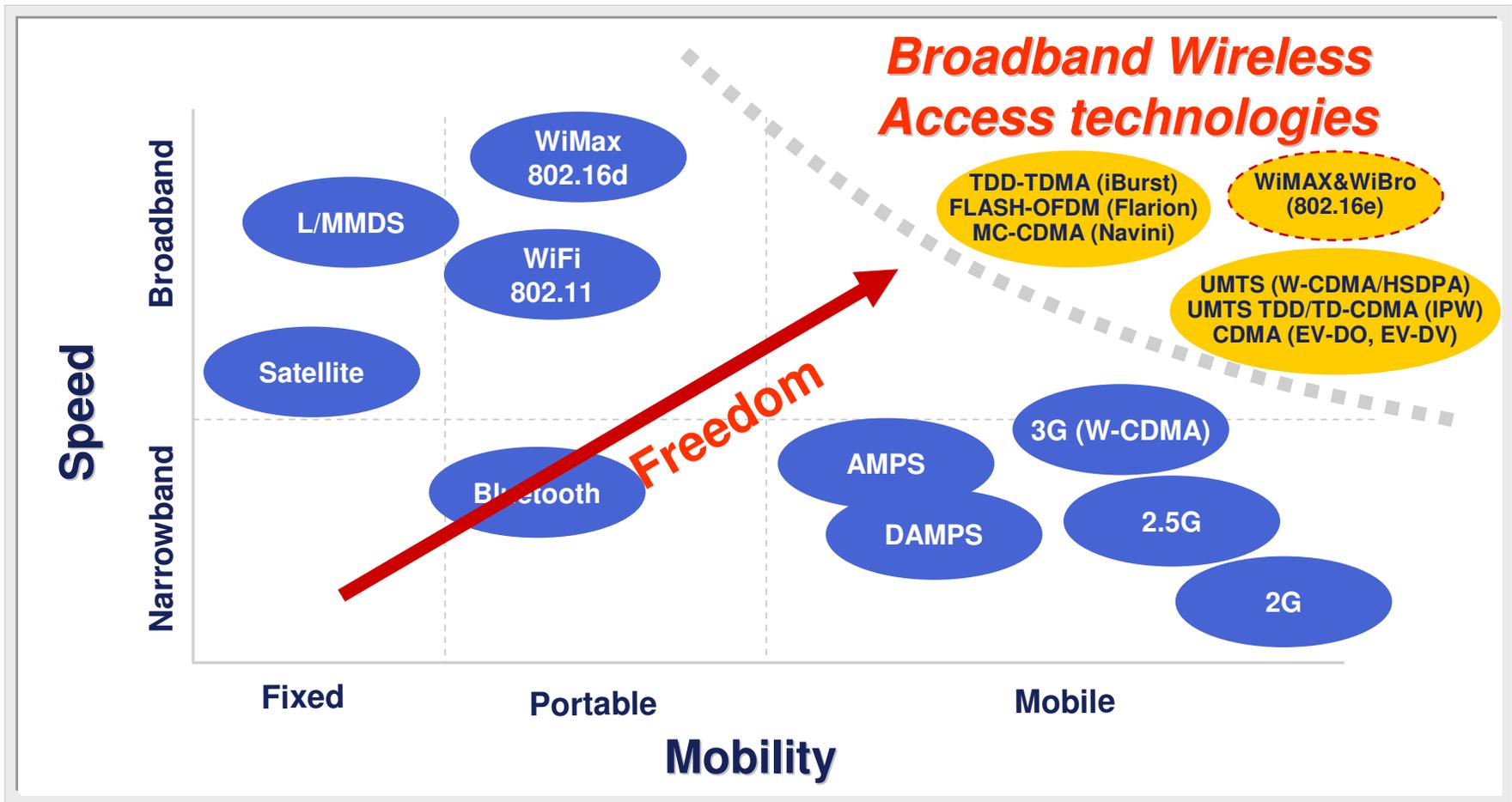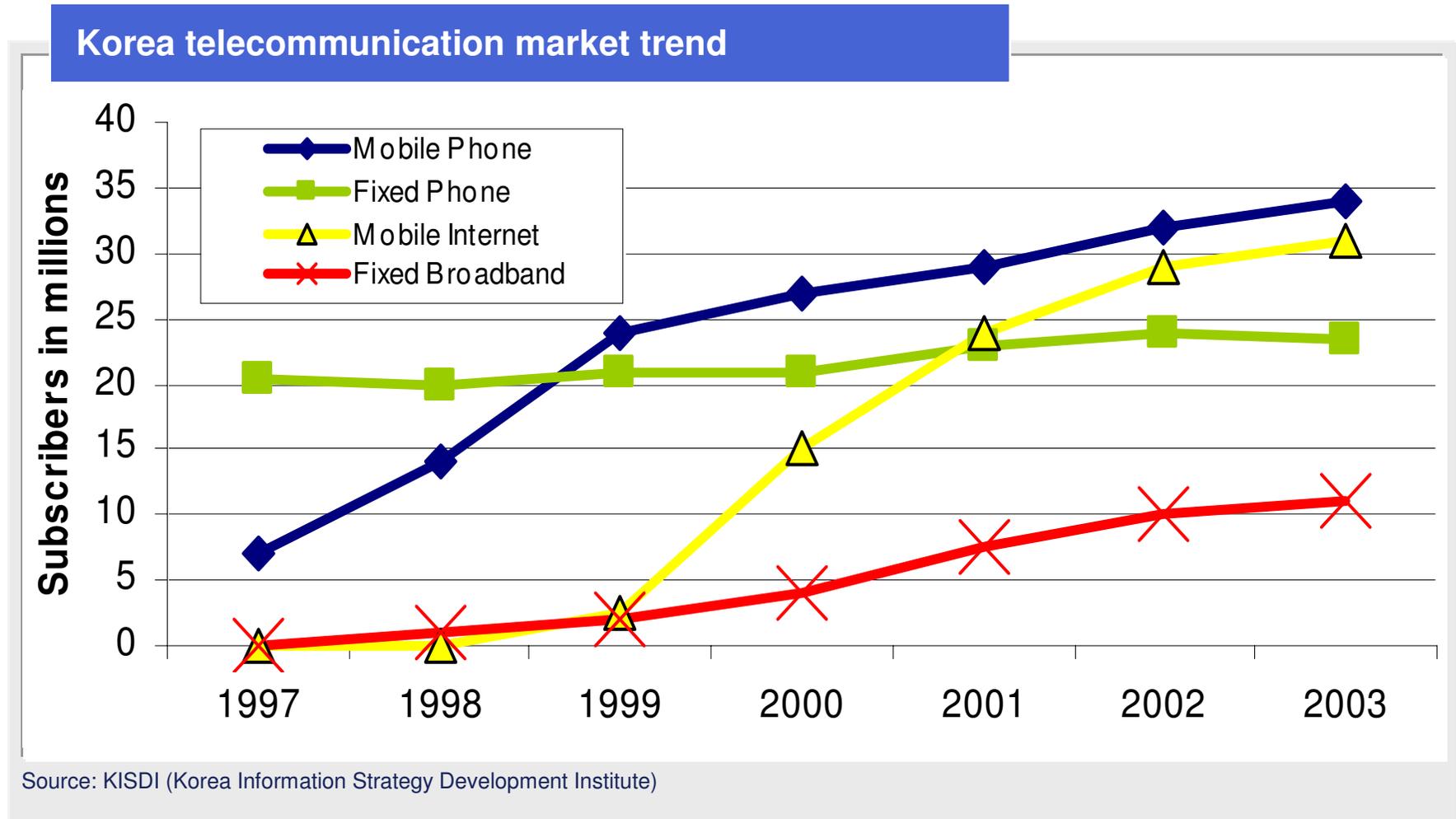
Mobile Broadband offering could potentially become interesting and successful mainly as an alternative access technology

Mobile Broadband Penetration

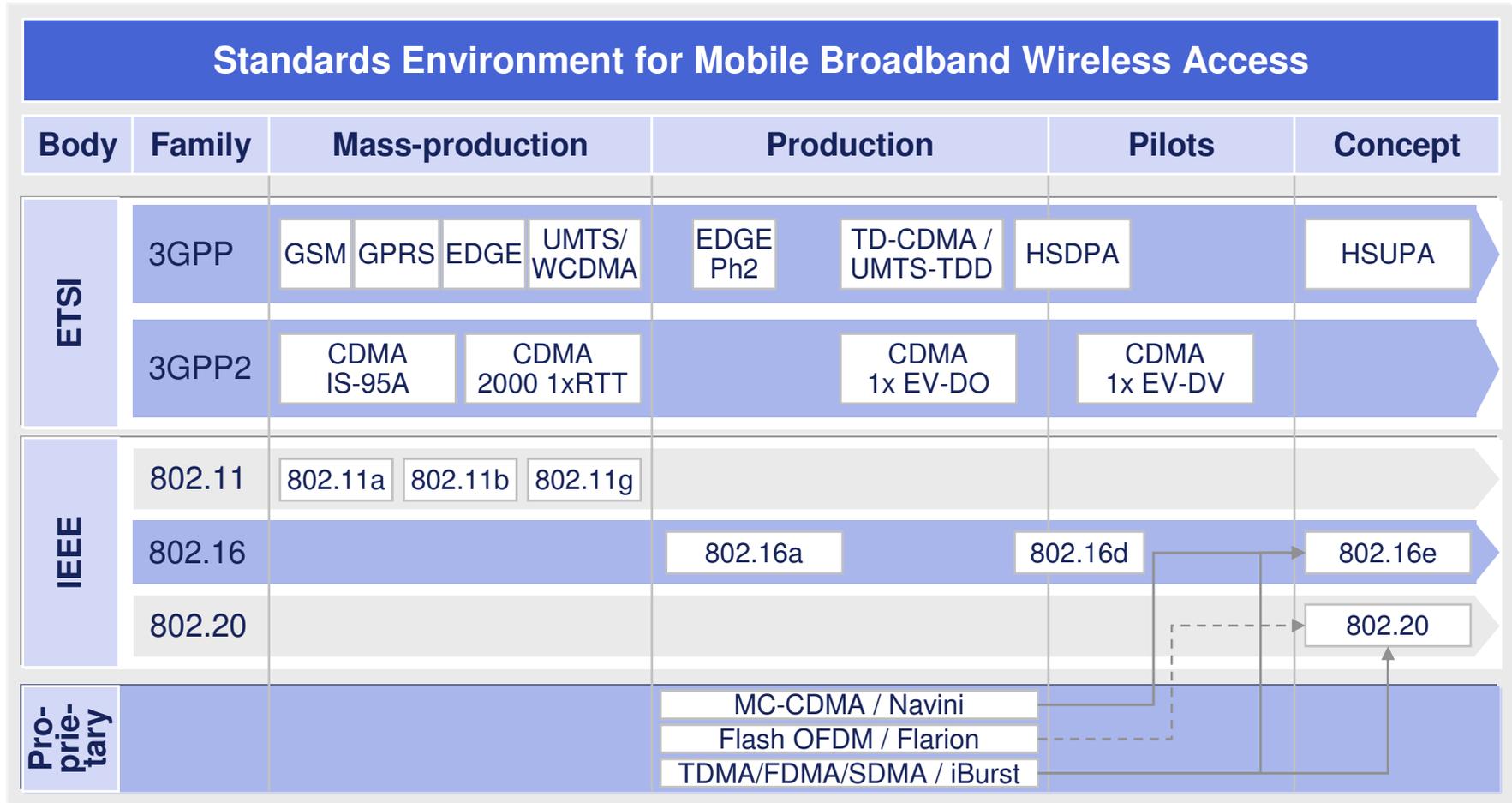% of Broadband Subscribers that also Subscribed to a Mobile Broadband Service
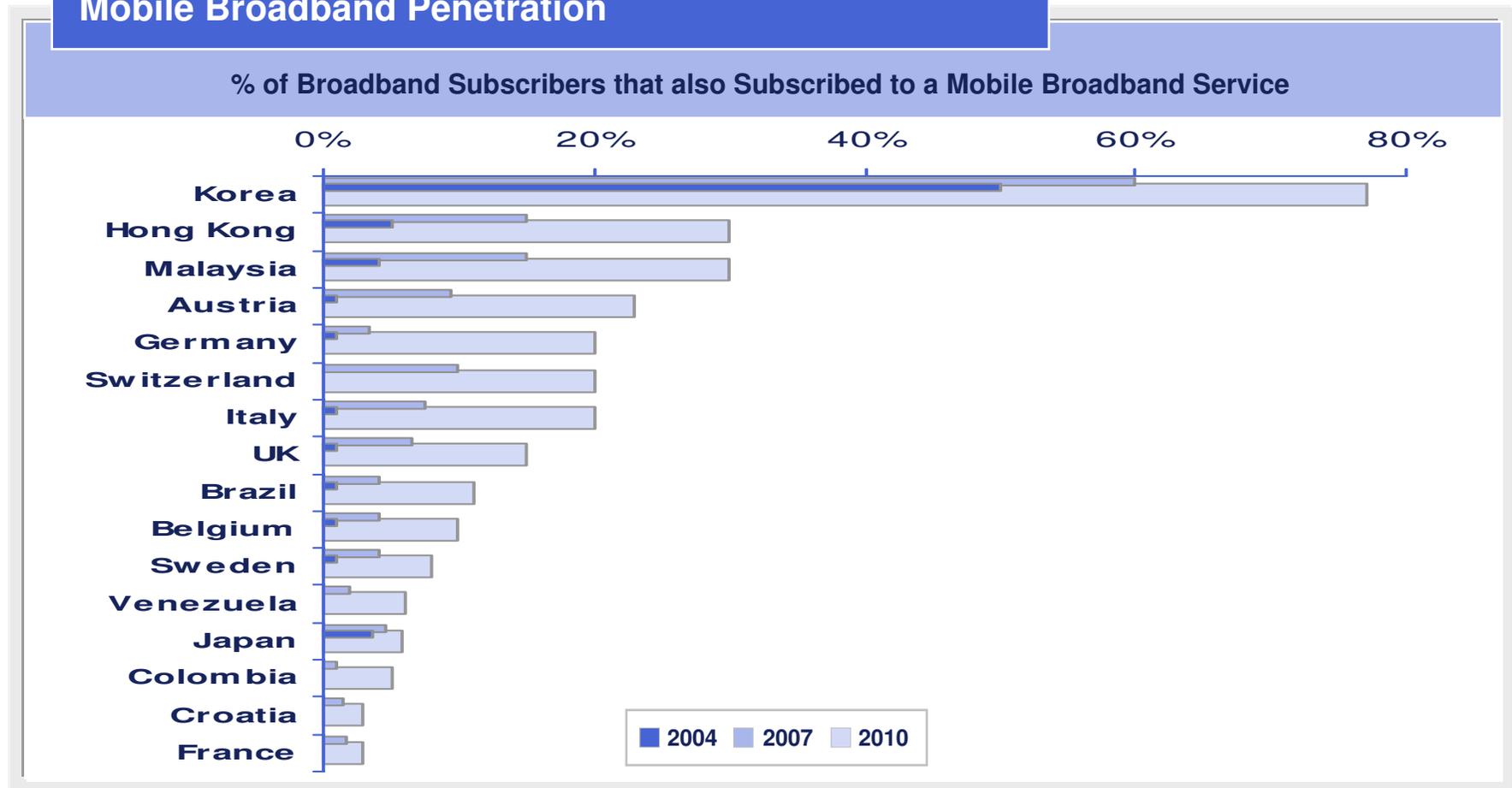
Source: Broadband update 2005 Interview Results

Mobile internet is one of the fastest growing service in Korea due to Broadband access offerings

Korea telecommunication market trend

Source: KISDI (Korea Information Strategy Development Institute)

There are at least three standard-families next to proprietary developments competing for dominance in MBWA

Standards Environment for Mobile Broadband Wireless Access

Body	Family	Mass-production			Production		Pilots	Concept
ETSI	3GPP	GSM GPRS EDGE	UMTS/ WCDMA		EDGE Ph2	TD-CDMA / UMTS-TDD 　 HSDPA		HSUPA
	3GPP2	CDMA IS-95A	CDMA 2000 1xRTT		CDMA 1x EV-DO		CDMA 1x EV-DV	
IEEE	802.11	802.11a 802.11b 802.11g						
	802.16				802.16a	802.16d		802.16e
	802.20							802.20
Pro-prie-tary					MC-CDMA / Navini			
					Flash OFDM / Flarion			
					TDMA/FDMA/SDMA / iBurst			

BWA systems support a variety of applications in the fixed and mobile environment

Segment of broadband wireless access technologies

Fixed Broadband wireless access

Mobile Broadband wireless access

WiMax (802.16a), iBurst, FLASH OFDM*, UMTS TDD*, CDMA EV-DO*, MC-CDMA ...

UMTS/HSDPA, CDMA-EVDO*, iBurst, UMTS TDD*, FLASH OFDM*, MC-CDMA, WiMax (802.16e) ...

*) Technological standards supporting the 450 MHz band being currently tendered in many markets together with the 3,5 Ghz licenses
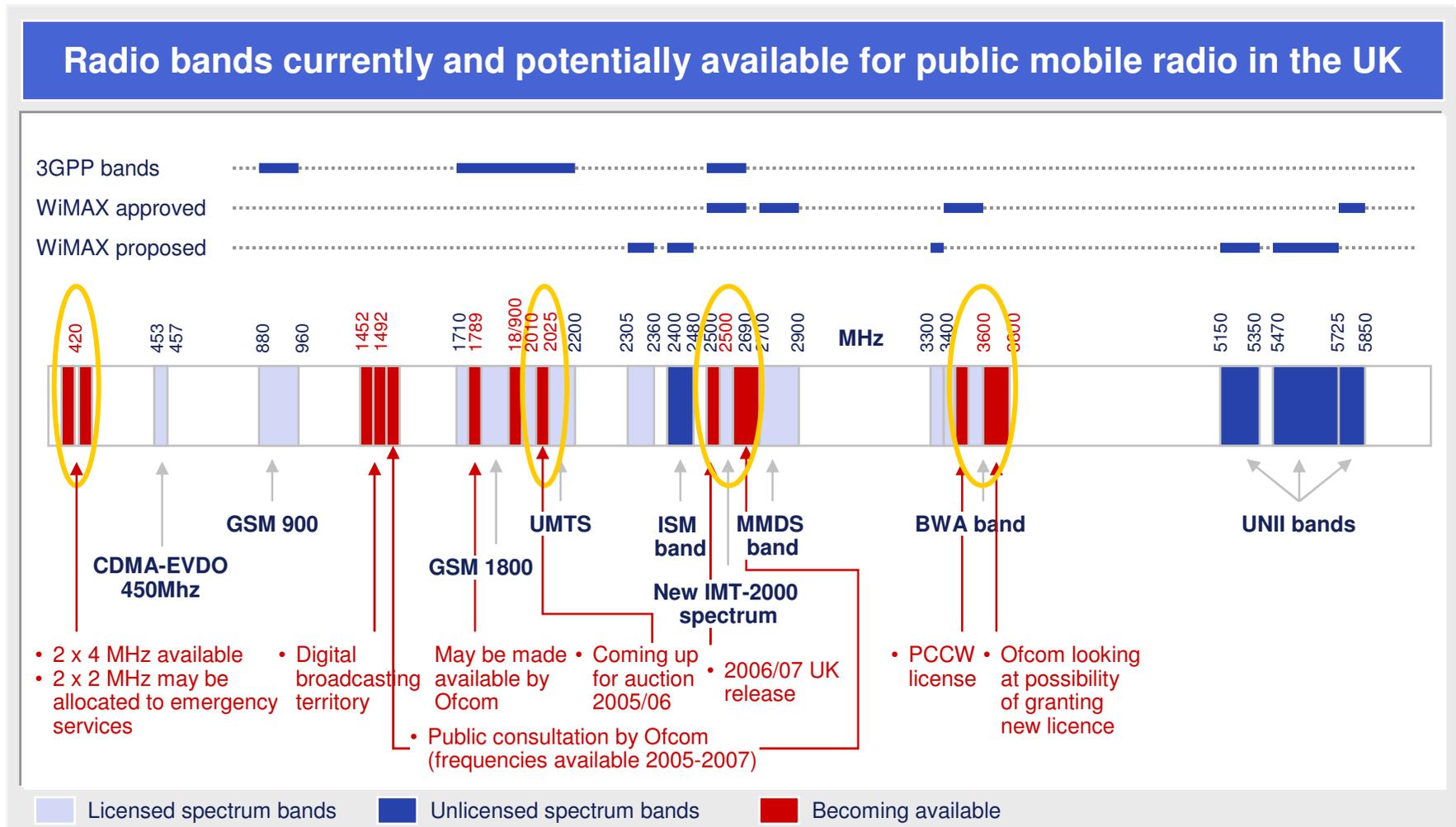
The increasing demand for a variety of rich applications and services over the telecoms infrastructure(s) increases the strategic relevance of capacity

Application / service	@home				On the move			
	Usage / demand		Potential platforms	Capacity constraints	Usage / demand		Potential platforms	Capacity constraints
	Today	2010			Today	2010		
Voice	~160 minutes / user / month	~100 minutes / user / month	PSTN / ISDN HFC	○	~110 minutes / user / month	~150 minutes / user / month	GSM UMTS CDMA MBWA Prop.	◔
Internet Access / Data	~400 MB / user / month	>1.000 MB / user / month	HFC DSL, PLC FTTH WiMax DVB-T	◐	~1 MB / user / month	~500 MB / user / month	GPRS/EDGE UMTS/HSDPA CDMA, MBWA Prop. WiMax, DVB-T	◔
Broadcasting / TV / Video	~2 hours / user / day	~2,5 hours / user / day	Analog Terr., Sat., HFC, DVB-T, TVoDSL	◕	~	~30 minutes / user / day	DVB-T/H, UMTS/MBMS, DAB/DMB, MediaFLO	●

➢ Consumer requires increasing variety of services that cannot be fulfilled on a single traditional platform
➢ Capacity becomes a strategic asset in competition – frequency acquisition and realization of capacity with effective technologies becomes essential to support customer needs @home and on the move

Source: Arthur D. Little

Ofcom intends to make more spectrum available at viable frequencies; furthermore spectrum trading will open new doors

Radio bands currently and potentially available for public mobile radio in the UK

- 3GPP bands
- WiMAX approved
- WiMAX proposed

CDMA-EVDO 450Mhz
- 2 x 4 MHz available
- 2 x 2 MHz may be allocated to emergency services

GSM 900
- Digital broadcasting territory

GSM 1800

UMTS
- May be made available by Ofcom
- Public consultation by Ofcom (frequencies available 2005-2007)

New IMT-2000 spectrum
- Coming up for auction 2005/06

ISM band

MMDS band
- 2006/07 UK release

BWA band
- PCCW license
- Ofcom looking at possibility of granting new licence

UNII bands

Licensed spectrum bands | Unlicensed spectrum bands | Becoming available

Arthur D Little

10

We have modeled the costs for rolling out Incumbent's proposed ten city network and have varied the spectrum / technology options

Comparison of total network rollout capex*
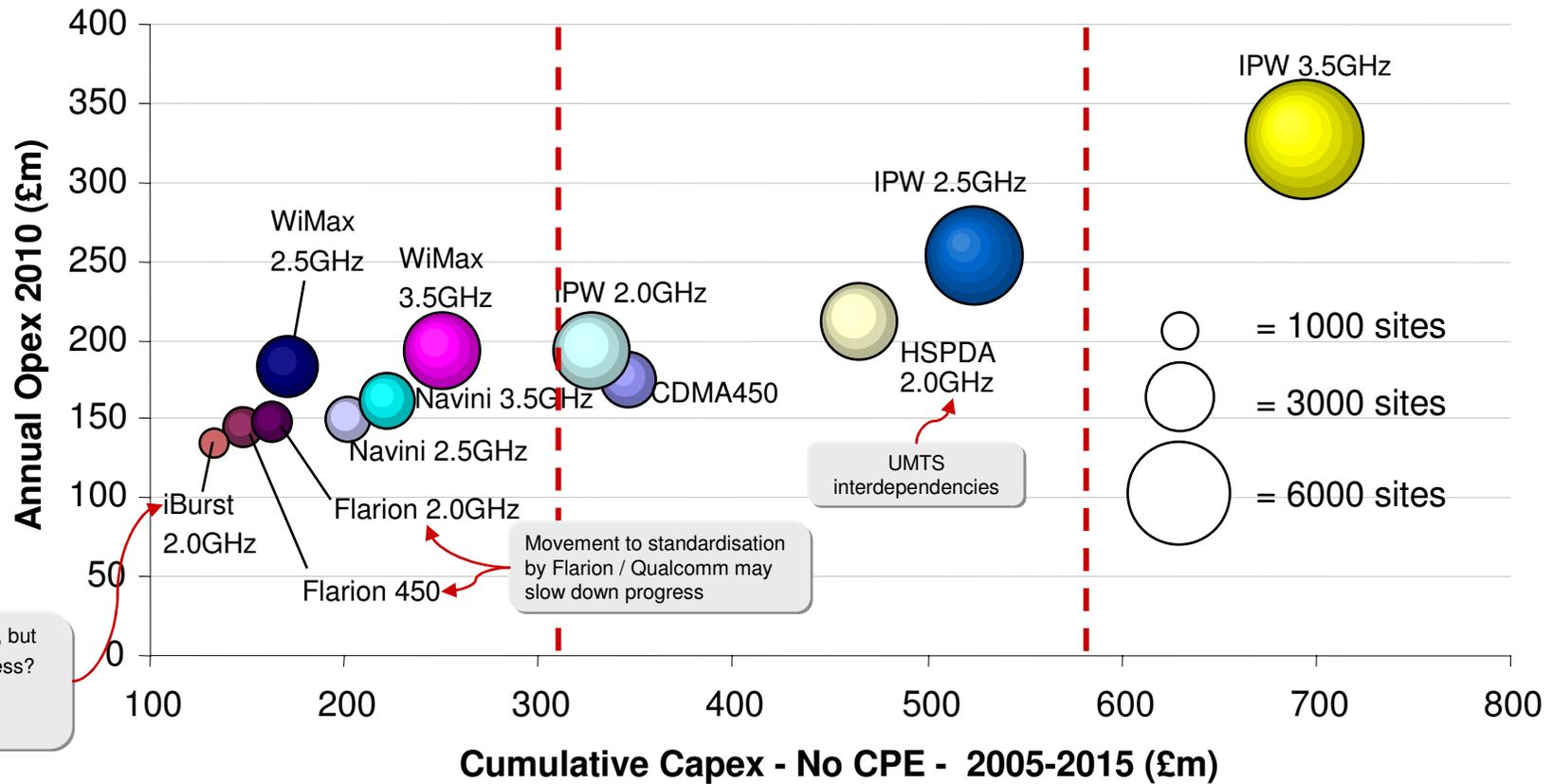
* Licence cost not included; CPE not included

Several strategic spectrum/vendor options are available – our case studies have shown how the different players in the market have made their choice
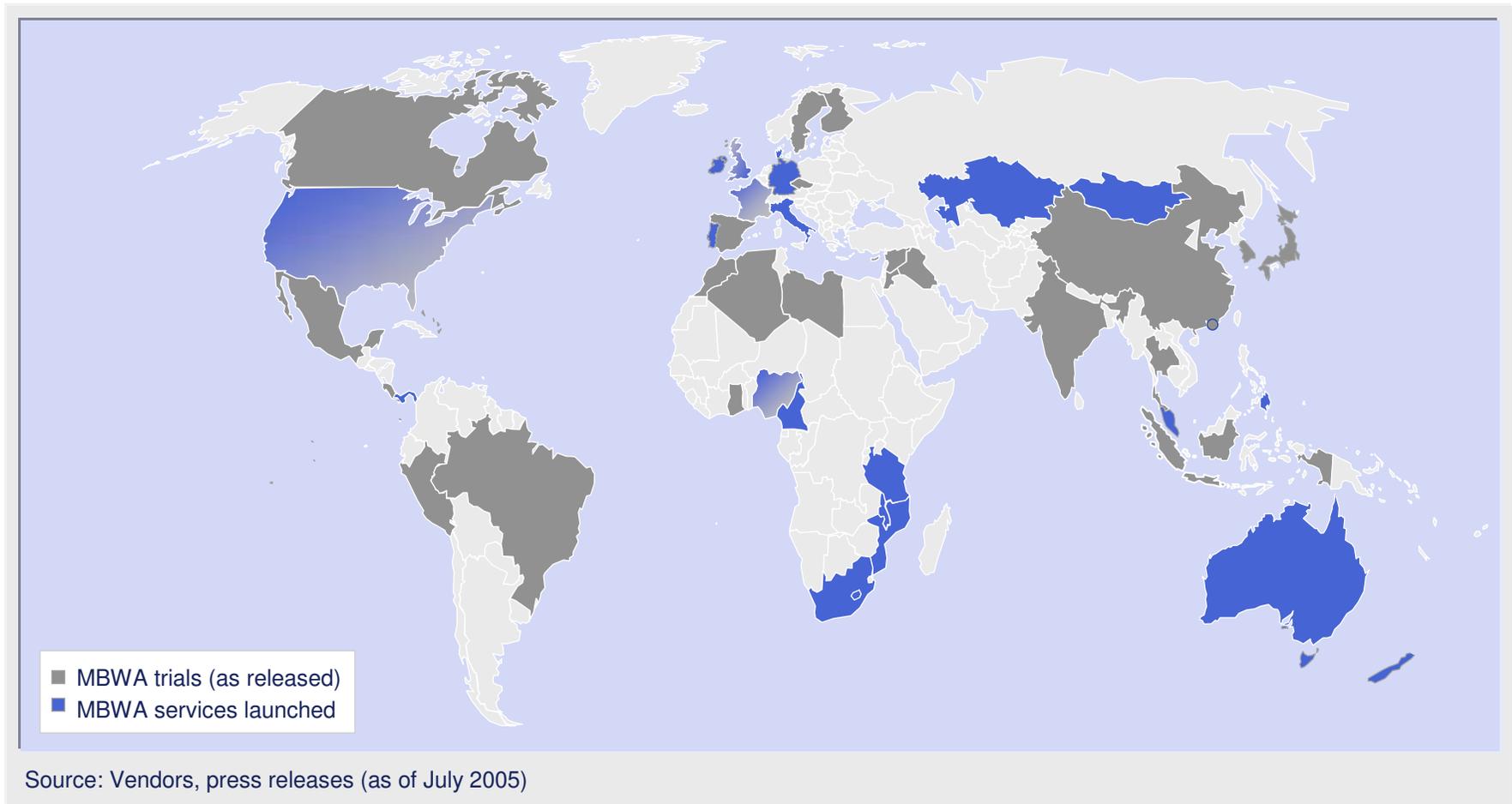

Strategic options for roll-out scenarios

Frequencies

1 420-450 Mhz
2 1.8-2.1 GHz
3 2.5 GHz
4 3.5-3.7 GHz

2.1 TDD & FDD
2.2 FDD
2.3 TDD

CDMA EV-DO or IPW | **Flarion (Flash OFDM)**

WCDMA & IPW or Flarion | **HSDPA & IPW or iBurst**

WCDMA → **HSDPA**

IPW | **iBurst**

WCDMA HSDPA | **IPW or Navini** | **WiMAX***

IPW or Navini | **WiMAX***
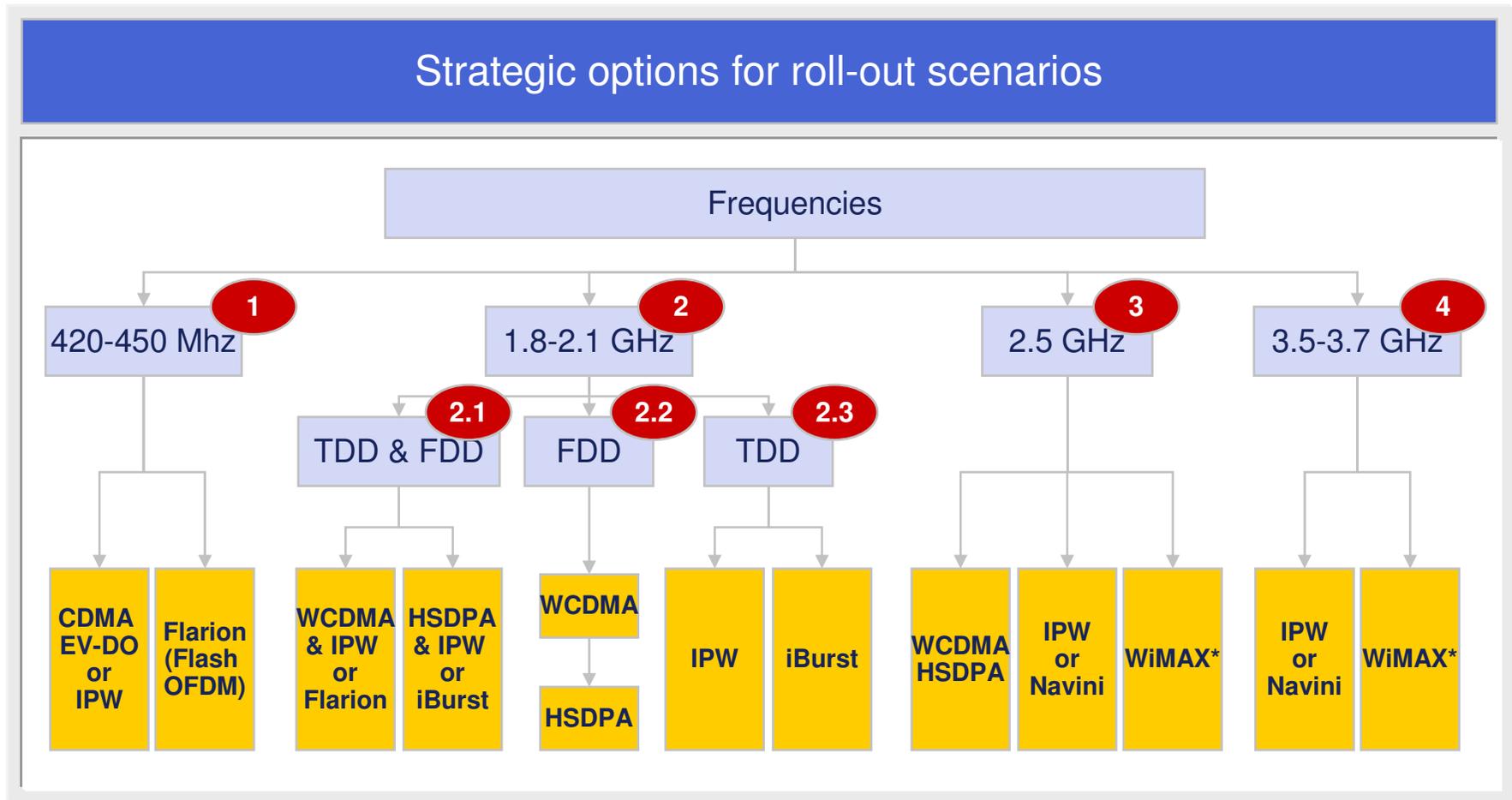
*) pre WiMAX suppliers e.g. : Aperto, Airspan, Alvarion, Proxim, Redline, WiLAN

Decisions | Sub-Options

Contents

2

MBWA is developing all over the world - Many network trials implemented over the past 20 months are now rapidly migrating to full network launches

■ MBWA trials (as released)
■ MBWA services launched

Source: Vendors, press releases (as of July 2005)

Woosh, an advanced provider from New Zealand, is offering a wide range of wireless Internet products for residential- as well as for business customers

Woosh – New Zealand

The Woosh difference

- Woosh is the first high-speed Broadband Wireless Service Provider in New Zealand
- Targeted segments (examples)
  - Residential: "Woosh Everyday" with unlimited access for 54.95 NZ$ (US$ 33.90) - design speed 250kbps
  - Business: "Woosh Business 10" with 10 GB monthly for 359 NZ$(US$222) - design speed 350kbps
- Woosh also offers business solution services (bandwidth on demand, VPN etc.)

The launch of Woosh's VoIP over TD-CDMA in Sept 05 was well recognized by the industry indicating that the low priced service could become a serious threat for the tradional Voice players

Woosh launches voice … that could mark trouble for telcos … Broadband customers now have a range of options for voice calling…
(Computerword Sept 05)

Phone + Internet

- New Zealand MBWA operator Woosh Wireless launched a VoIP phone service over TD-CDMA in September 2005
- The service covers the area of Auckland yet but is to be extended soon
- Users will be able to retain their current phone numbers
- However phones must be plugged into a Woosh appliance (the system does support wireless handsets that work from a standard base station)
- Woosh announced that the tariff plans represent savings of up to 50 percent on similar packages from other providers
- Phone connections to residential customers and small businesses are available from 11-14 Euro per month on top of Woosh broadband plans (plus 5 cent per minute with unlimited free local calls)

Given the pressure of the mobile operator and the new start-ups the Fixed incumbent operator just launched a mobile Broadband service

Case studies

Start-up vs. Incumbent: Telstra's reaction February 2005

Servicing more than 5000 customers, Irish Broadband is specialized in low-cost wireless internet access and has a range of Broadband wireless products in its portfolio

Case studies

Irish Broadband - Ireland

IRISH BROADBAND
internet with attitude

Antenna:

7" tall with antenna up

2" wide

4" tall with antenna down

4.5" long
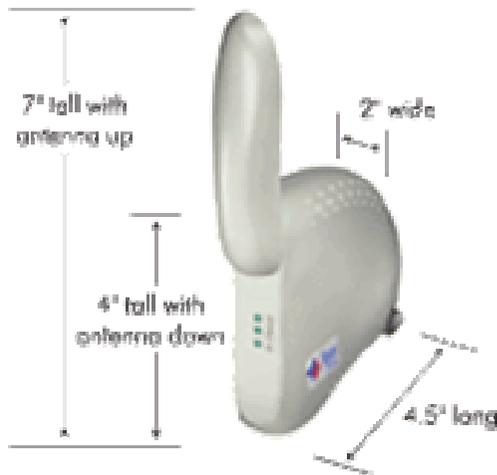
- Founded in 2002, Irish Broadband is committed to cost-effective delivery of Internet access (flat rate!)*
→ 512Kbps residential service costs 24.99 euros/mth., and the 1Mbps product costs 38.99 euros ; business services prices are 48/162/300 euros/mth. for 2Mbps/3Mbps/4Mbps (all prices include VAT)
- Currently (June 2005) 35 base stations – claimed increase of 100 in Dec 2005
- 5000 customers in December 2004
- Equipment supplied by Navini (for residential), Airspan and Stratex Networks (for business)
- Last investment round: €18M in Dec 2004

Source: Arthur D. Little Research, as of June '05

* these prices are competitive by current Irish, if not by other countries' pricing levels

Arthur D Little

Wireless Business Solutions, a South African telecommunications provider, launched its iBurst MBWA network operating in 4 cities

Case studies

WBS – South Africa

- Wireless Business Solutions (WBS) is the fourth telecommunication licensee in South Africa and launched its iBurst network in 2004
- Geographical market: South Africa (current coverage in Cape Town, Johannesburg, Pretoria and Durban)
- June 2005: 6000 customers and 33 live base stations
- Product offering for 1/3/6/9 GB per month solutions (flat rate); PCMCIA and modem CPE
- Pricing: 57€ for 1GB. 73€ for 3GB and 110€ for 6GB free download volume
- Planned services: VoIP (including handheld CPE), QoS, LBS
- Planned coverage: EOY 2005 6-8 cities covered servicing more than 15.000 subscribers
- Sales channels: WBS direct and resellers
- Cooperates with Arraycomm, UTStarcom, Kyocera and Uunet

Arthur D Little

First results indicate a clear success story: 49k customers and 23% broadband market share one year after launch

Case studies

Eurotel – First Results

Initial Situation	Results 4 month after launch

Initial Situation

- Eurotel (leading Czech GSM Operator) has commercially launched its CDMA 20001x EV-DO network operating in the 450 MHz radio spectrum in August 2004

- The following tariffs were applied:
  - The service: CZK 799 (Euro 27) - average connect speed 1Mbps (unlimited access) with FUP
  - The wireless modem: CZK 9995 (Euro 330)

Results 4 month after launch

- The MBWA experiment turned into a clear 'success story' for the operator so far

- One year after the initial launch, Eurotel is reporting the following figures:
  - **49.000 paying customers** joined the service, up 63% from YE 2004
  - **23% broadband market share**
  - **weekly orders – currently around 500**
  - **80% coverage**

Updates
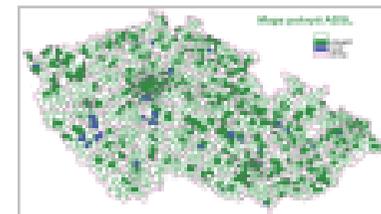
Eurotel

Eurotel and CeTe have settled the conflict – today they conjointly leverage synergies between fixed and mobile by offering attractive product bundles

Case studies

Eurotel / Czech Telecom Synergies

CeTe Group

Eurotel	Czesky Telecom / Express

Eurotel Mobile Voice & Data Packages
- Bundles broadband + mobile voice
- Choice from 3 broadband speeds
- Technology independent offers including GPRS/EDGE, ADSL and CDMA

CeTe Internet Packages
- Choice from 4 simple Internet bundles defined by customer needs (home, mobile, pro, kombi)
- Technology independent offers including ADSL and CDMA

Internet Expres
Profi
999 Kč
Expres

➡ **Technology independent packages; strategy does NOT focus on the technology but rather on the solution (price, included volume, speed ➔customer's benefit)**

Considering wireline as well as wireless, the CeTe Group has been serving 212k broadband customers by 1H/2005

Eurotel / Cesky Telecom Broadband Coverage

Eurotel

ČESKÝ TELECOM

WIRELESS BROADBAND

- Over 49.000 customers

- 80% population coverage

WIRELINE BROADBAND

- Over 163.000 customers

- 90% of CTc lines enabled

- available to 3.000.000+ households

CDMA existing
CDMA planned
(end Feb 2005)
ADSL
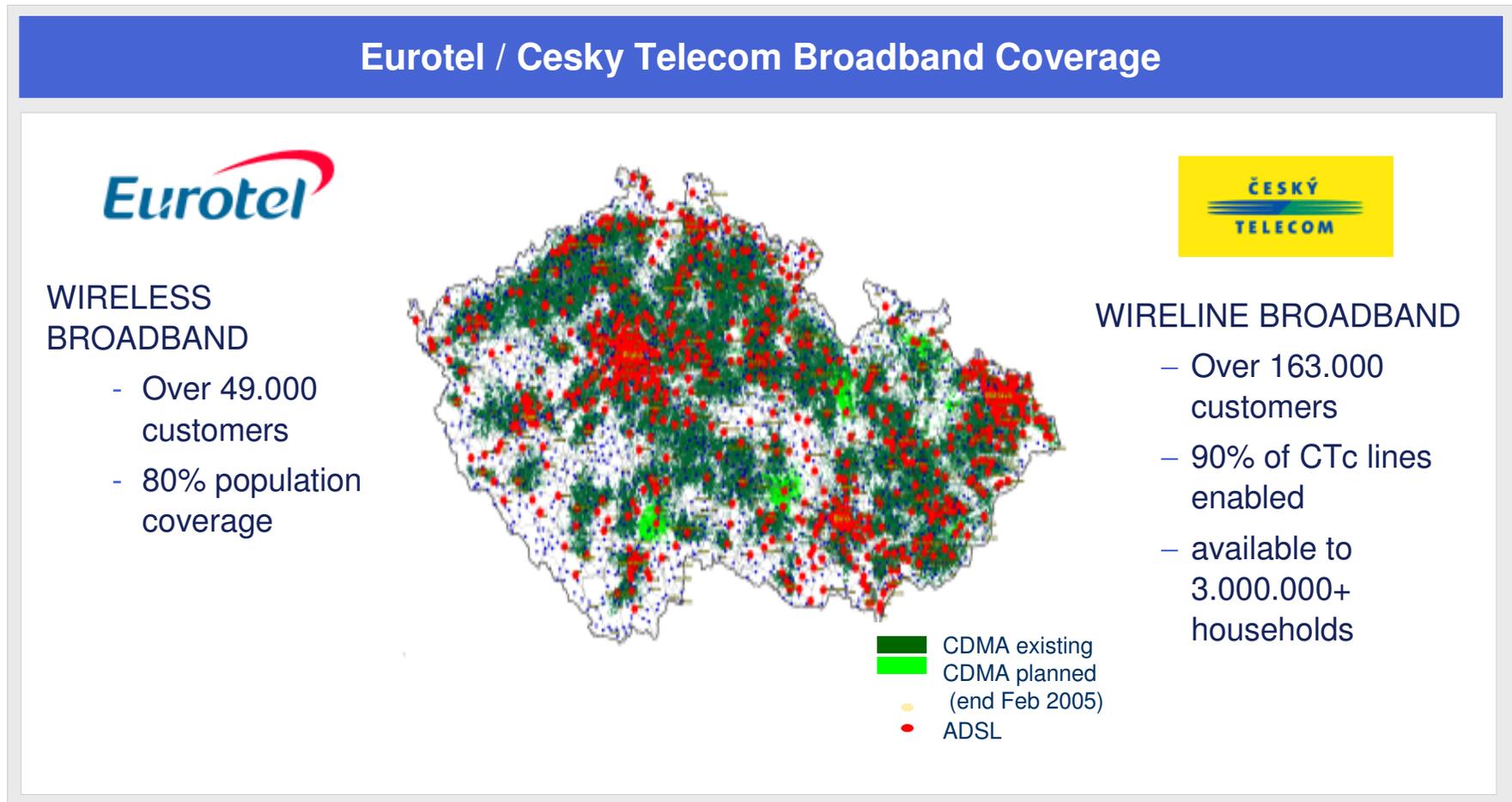
Despite its initial UMTS rollout, T-Mobile CZ has acquired 872 MHz frequency spectrum and is using its 5 MHz TDD UMTS band to develop a mobile broadband service based on IPWireless TD-CDMA technology

Case studies

T-Mobile – Czech Republic

- T-Mobile acquired 872Mhz spectrum in the Czech Republic
- Using IPWireless TD-CDMA technology T-Mobile has launched a wireless broadband network in Prague in October 2005
- Tariffs: 3GB package for 33 Euro, 10 GB for 47 Euro
- T-Mobile will extend its footprint through summer of 2006 to cover nearly half of the Czech population (85 cities) with UMTS TDD technology
- T-Mobile uses unpaired 1,9GHz frequency spectrum for the UMTS TDD network
- In addition 2,5G network will be fully upgraded to EDGE and 3G network to UMTS FDD (HSDPA/HSUPA) as soon as commercial solutions are available
- T-Mobile aims to completely substitute fixed line ADSL with its service

Source: Arthur D. Little Research, as of October '05

Verizon is already providing Wireless Broadband services in 32 markets and launched a EV-DO consumer offering and further aggressive rollouts are being planned to cover 150 m people altogether by end of 2005

Case studies

Verizon - USA

- First nationwide carrier to offer business and consumer broadband services based on EV-DO technology in the US

- Service is offered at $79.99 flat rate - PC card is priced at $150

- Feb01, 2005: Launch of EV-DO; Application "VCAST" (video on demand, online gaming, etc.) available for 15$ in addition to regular calling fees

- Customer devices are primarily PCMCIA cards and EVDO handsets (provided by Motorola, LG and UTStarcom)

- Service is already offered in 32 major markets (Feb.'05)

- Claims to prepare rollout in 12 additional markets (most of them metropolitan) and cover 150 million people by end of 2005

- Advertises download speeds of 300-500kbps

Finish Digital TV company Digita won an operating license to build a 450Mhz wireless broadband network on June, 22nd 2005 becoming the 1st FLASH OFDM roll-out in the word

Case studies

Digita - Finland

- Founded in 1999 as subsidiary of Finish Broadcasting Company, Digita Oy is responsible for national transmission and broadcasting networks as well as for radio and television stations
- On 22nd of June 2005, Digita was granted an operating license to build a wireless broadband network
- Using Flash-OFDM technology the network will be based on 450Mhz frequency
- 3 stages for deployment: rural areas (Lapland, Eastern Finland) to be covered by Sept 2006, almost national coverage by Dec 2007 and full coverage by Sept 2009
- The 450Mhz network will primarily be a complementary network to existing infrastructure covering regions which are not currently served by 3G and ADSL
- Digita´s role is restricted to construction and operation persuing an open shared network model
- Digita will not be service provider but service existing providers with bandwidth

Source: Arthur D. Little Research, as of June '05

O2 Germany is mainly promoting the independence from wireline at home with a least monthly saving of € 30,- as a value proposition bundling voice and data

Value proposition

O2 - Germany

O2 Germany

O₂ Genion: mehr Unabhängigkeit vom Festnetz

GRUNDGEBÜHR

Voice — 9,99 €
Internet — 9,99 €

NUTZUNG ZUHAUSE

9,99 € Flatrate
14,99 € Surf-Pack (1GB inkl.)

TOTAL: ca. 45 Euro

Competition

Vergleichbare Festnetz-Mobilfunk-Angebote

GRUNDGEBÜHR

Voice — 15,95 €[1]   9,99 €
DSL Internet — 16,99 €[3]

NUTZUNG ZUHAUSE

~20 €[2]   ~12 €[4]

TOTAL: ca. 75 Euro

- ■ **'O2 Genion flatrate'**
  - ➤ €9,99 montly,
  - ➤ calls in the German fixed network and in O2's home zone network included
  - ➤ for all O2 Genion customers with or w.o. handsets
  - ➤ trial, first 3 months for free and cancellable any time
- ■ **'O2 surf @ home'**
  - ➤ UMTS router for € 49,99 or € 99,99
  - ➤ 3 packages 500 Mb, 1 Gb and 2 Gb for resp. €9,99, €14,99 and €21,99

1) DTAG Preisliste für Analog Anschluss. Bei ISDN weitere 7€ Ersparnis pro Monat, da monatlicher Grundpreis ISDN 23,95€
2) Durchschnittlicher Umsatz pro Kunde im Monat auf Analysys Research Limited 2004
3) Standardpreis DSL Reselling
4) Durchschnittlicher Umsatz pro Kunde im Monat laut Yankee „European Broadband Dashboard" Mai 2005

O2 Germany offering 4 tariff plans for the broadband data consumption usages and volume based leaving a large choice for users at "home"

Value proposition
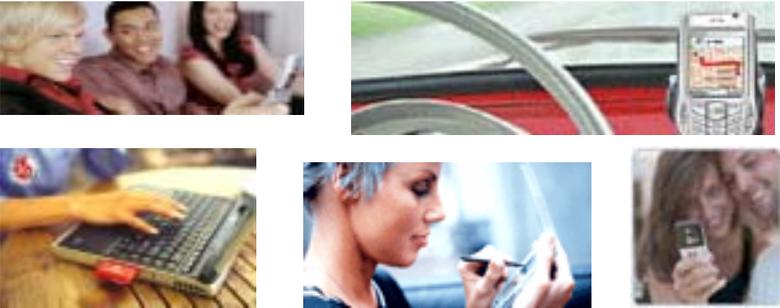

O2 - Germany

- **'O2 surf @ home'**
  - without Surf-Pack, usage based €cents 3
  - 3 packages 500 Mb, 1 Gb and 2 Gb or
  - 10hrs, 20 or 40 for resp. €9,99, €14,99 and €21,99
  - Subscription fee € 9,99

O2 and Vodafone are leading the pack with regards to UMTS based broadband offers since March 2005

Case studies

O2 - Germany	**Vodafone - Germany**
■ "**Surf@home**" offer since March 2005	■ "**Vodafone Zuhause Web**" offer since March 2005
■ UMTS based internet service within the customer's predefined home zone	■ UMTS based internet service within the customer's predefined home zone
■ Surf@home base fee of **9,99 Euro/ month**	■ "Vodafone Zuhause Web" base fee of **16,99 Euro/ month**
■ Service can be ordered with or without "Surf-Packages"; without Surf-package the minute is priced at **3 cents per minute**	■ Service available with time and volume based packages
■ Surf-packages available including 10 (**9,99 €**), 20 (**14,99 €**) and 40 (**21,99 €**) hrs. of online time	■ Packages priced at **16,95 Euro** including either 60 hrs. online time or 500 MB online traffic
■ Additional online minute for **3 cents/ min.**	■ Additional online time/ traffic for **25 cents per 10 Minutes or MB**
■ Installation fee of 24,99 Euro	■ Hardware "Zuhause Talk & Web-Box" will be offered later this year; **Vodafone Mobile Connect Card** available for 1 € within this offer
■ Hardware **"surf@home"-box** necessary and priced between 50 and 100 Euro (depending on the ordered package)	

Austrian mobile operators are targeting the mass market with their 3G service solutions

Distribution channels in Austria are heavily promoting bundled packages of notebooks and PCMCIA cards

Hartlauer

Niedermeyer

- Notebook with PCMCIA card from A1 or T-Mobile
- Price reduction for notebook of 100 EUR

- Cross Selling offerings of Notebook and PCMCIA cards
- Test stations for data cards in every shop

Mobile broadband services are promoted 6 months before the availability of the products claiming a leading position in the broadband arena

T-Mobile	Environment
	■ True competition on MBWA is already happening in Austria ■ Few hours after mobilkom Austria announcing the launch of HSDPA based broadband services T-mobile followed ■ Creating awareness to the mass market being the "true" broadband operators has started 6 months before the availability of the technology ■ HSDPA is "claimed" to be more effective than ADSL

Most aggressive players are start-ups and alternative mobile operators, having most freedom to pursue different market entry strategies
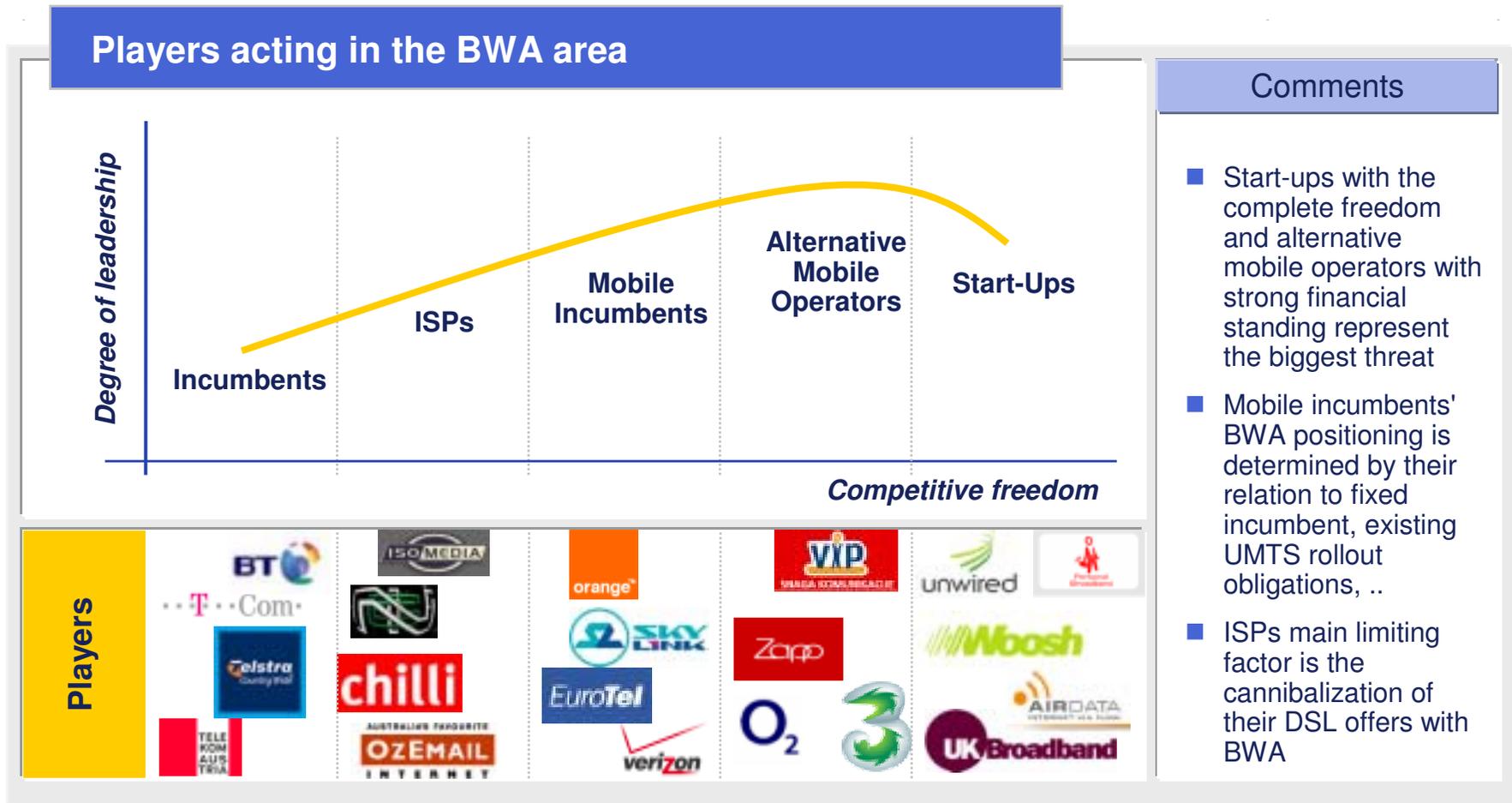
Players acting in the BWA area

Degree of leadership

Incumbents

ISPs

Mobile Incumbents

Alternative Mobile Operators

Start-Ups

Competitive freedom

Players

Comments

- Start-ups with the complete freedom and alternative mobile operators with strong financial standing represent the biggest threat

- Mobile incumbents' BWA positioning is determined by their relation to fixed incumbent, existing UMTS rollout obligations, ..

- ISPs main limiting factor is the cannibalization of their DSL offers with BWA

Contents

Arthur D Little

Today, the voice market is huge – however, growth will primarily come from the two data segments

Market sizes today	
Stationary	**Mobile**

Data

Voice

Market size in € in 2005   Market size in € in 2010
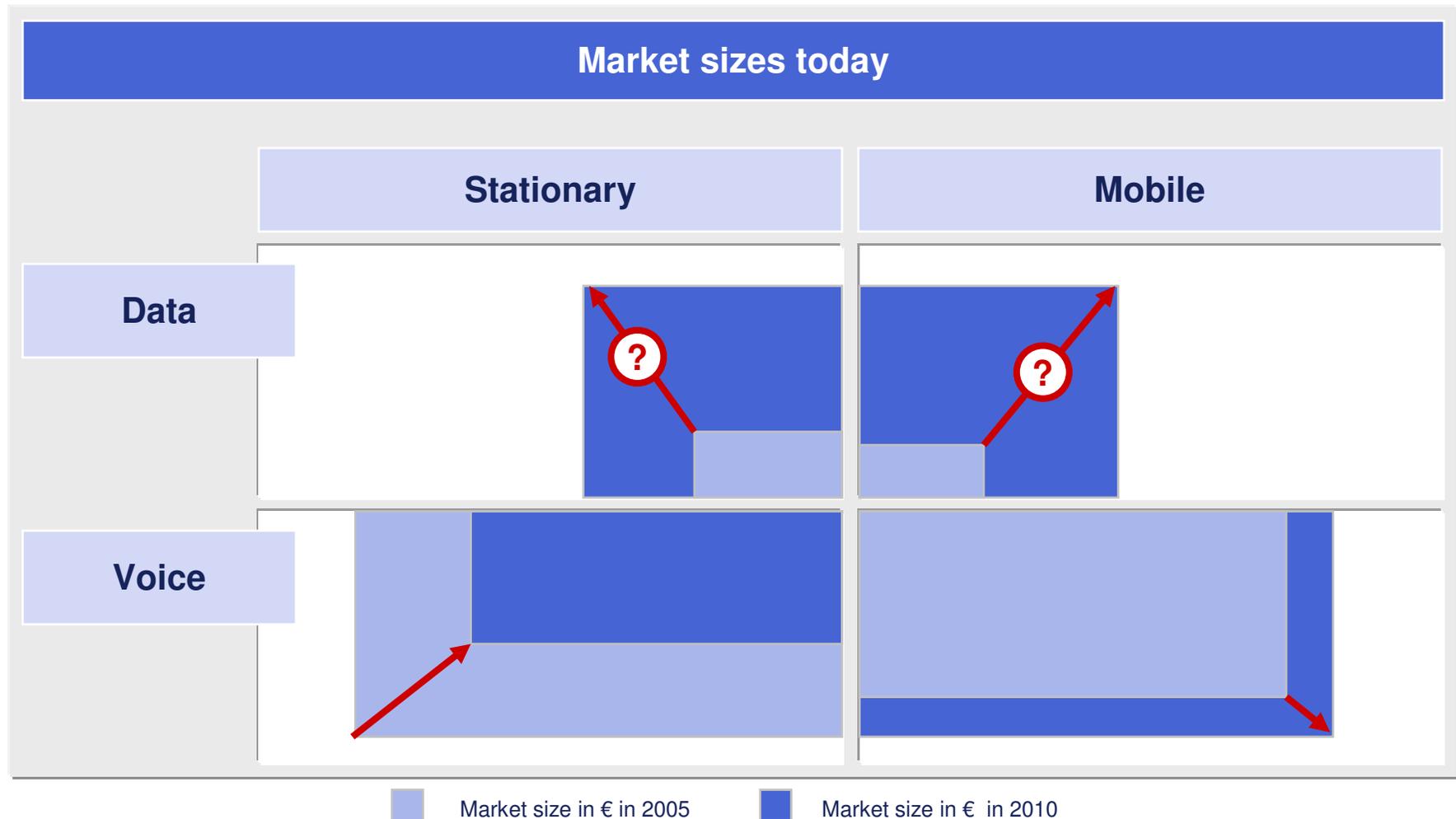
The same success factors apply for MBWA as they did for GSM 10 years ago – giving MBWA a similar threat potential to DSL as GSM did/does to the PSTN

Increasing importance of mobility for voice traffic

KSFs

Increasing importance of mobility for broadband

Many Drivers

Attractive devices (Handy=Lifestyle)

Mobility (Gains in efficiency)

(progressively) affordable pricing

Few Inhibitors

Simple usage

acceptable quality
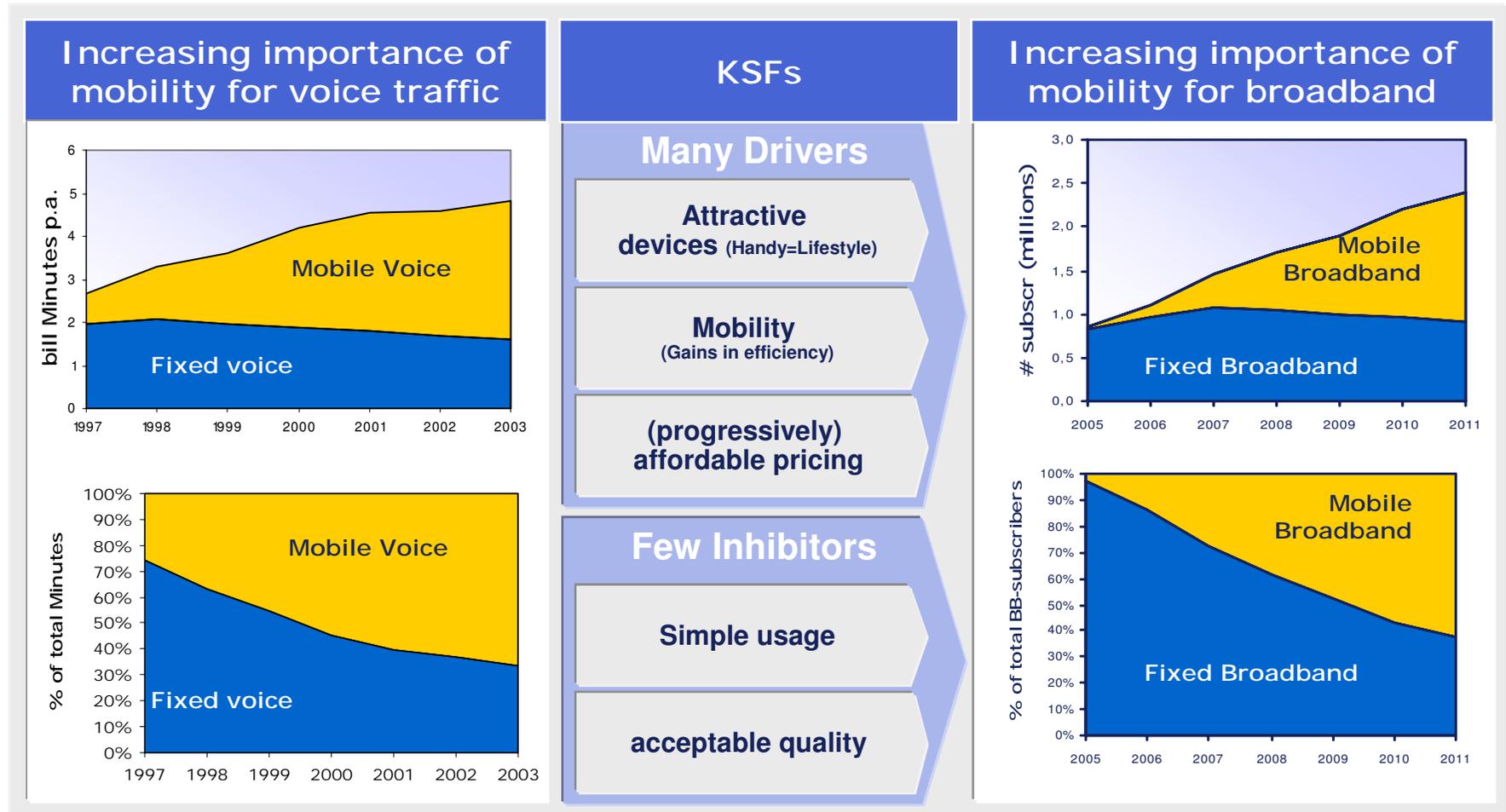
Overall broadband revenues continue to grow until the end of period with a limited uptake of mobile broadband

Case Study

"Conservative" Annual revenues in m€

- 3G BB Data
- Wireless modem
- PCMCIA
- DSL/HFC

in Euro (million)

xx0 · xx0 · xx0 · xx0 · xx0 · x0 · 0

2004 · 2005 e · 2006 e · 2007 e · 2008 e · 2009 e · 2010 e

"Mobile takes it all" Annual revenues in m€

in Euro (million)

xx0 · xx0 · xx0 · xx0 · xx0 · x0 · 0

2004 · 2005 e · 2006 e · 2007 e · 2008 e · 2009 e · 2010 e
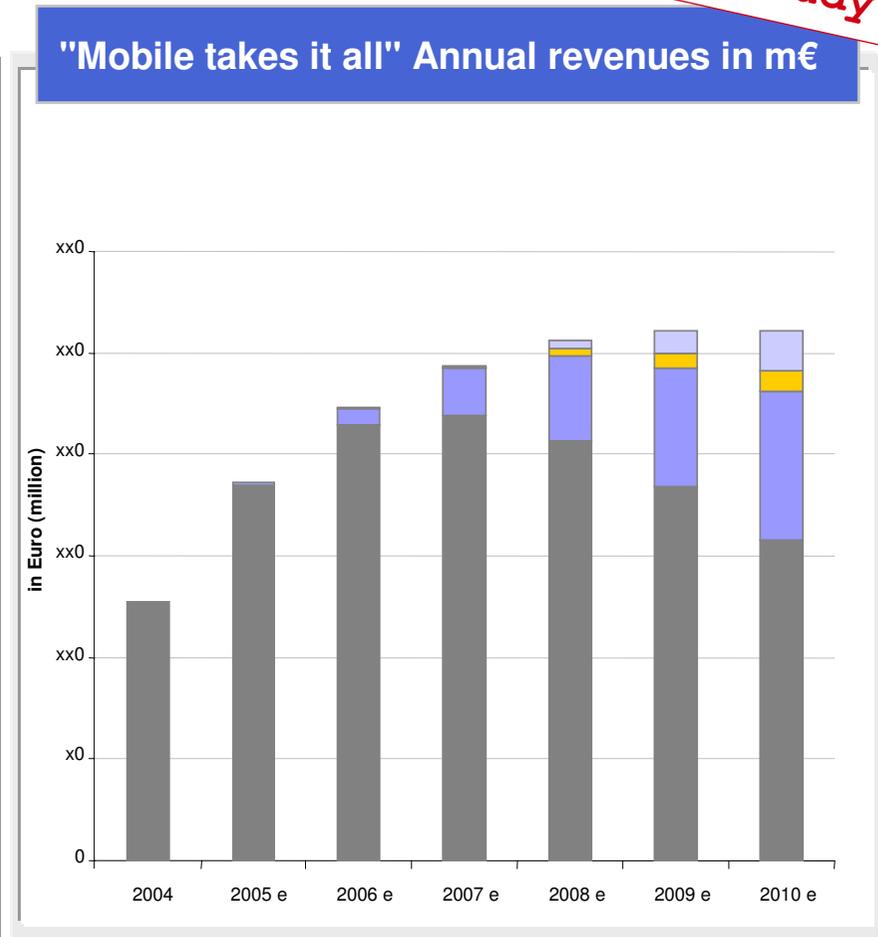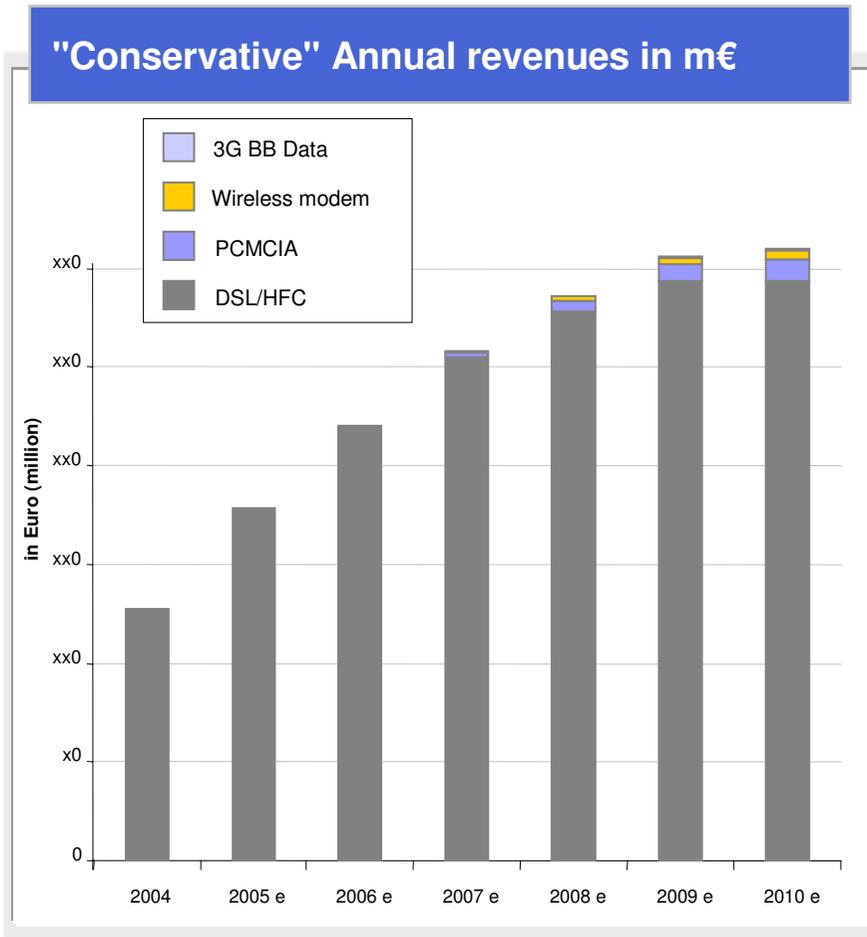
In the next 5 years, 2 out of 3 scenarios will heavily impact the Incumbent due to the high uptake of mobile broadband

Case Study

Market Growth Potential Analysis 2005-2010

	Conservative		Balanced		Mobile	
	abs.	in %	abs.	in %	abs.	in %
Total Broadband Penetration 2010	x.085,9		x.190,6		x.303,6	
Traditional Broadband	x.050,2	28 % HH	xx84,2	27 % HH	xx69,6	23 % HH
Mobile Data	35,7	0 % pop	xx06,4	2 % pop	xx34,0	4 % pop
Mobile share in %	3%		17%		33%	
Cumul. net adds 2005-2010	x57,9		x62,6		x75,6	
DSL / HFC	x05,3	93%	**x60,6**	**65%**	**x95,0**	**40%**
Wireless Modem	16,9	2%	**xx5,6**	**11%**	**xx6,5**	**15%**
3G Data	3,9	1%	**xx5,1**	**6%**	**xx6,1**	**11%**
PCMCIA	31,8	4%	**xx1,2**	**18%**	**xx7,9**	**34%**
	2005	2010	2005	2010	2005	2010
Blended ARPU in EUR						
Traditional Broadband	36,9	24,2	37,2	22,0	37,4	18,1
Mobile Data	n.a	33,8	n.a	26,8	n.a	21,3
Mobile premium in %		40%		22%		18%
Cumul. Revenue (in 000s)	x39,7		x77,0		x56,9	
DSL / HFC	x23,7	98,1%	**x31,3**	**83,4%**	**x38,6**	**62,9%**
Wireless Modem	x0,0	1,2%	**x4,6**	**3,9%**	**x6,1**	**8,9%**
3G Data	x,6	0,4%	**x4,1**	**2,8%**	**x6,5**	**4,3%**
PCMCIA	x,3	0,3%	**x7,0**	**9,9%**	**xx5,6**	**24,0%**

For existing operators, Broadband Wireless creates an opportunity to tackle some key market challenges

Fixed operators & ISPs

- Cover remote rural areas that can not be reached economically with DSL, HFC or fiber

- Follow the bandwidth-hungry, mobilizing (notebook, PDA) users by offering portable and mobile connectivity within the out-of-home and out-of-office locations they tend to frequent

Broadband Wireless Access Opportunity

Mobile operators

- Meet customers' need for higher bandwidth (not just enough for 3G phone "thin video" but for PDA or notebook surfing, email, serious downloads) reliably in real operational conditions, in dense urban and other demanding NLOS locations

- Offer services at competitive and affordable prices to foster fixed/mobile substitution of data revenues

- Enable fixed voice service based on VoIP integrated in wireless modems

Contents

1	Demand for MBWA
2	Case studies
3	The Drivers for BWA
4	**Implications for operators**

Although there are very promising business opportunities offered via Mobile Broadband Wireless Access, a wide range of risk factors have to be assessed and mitigated

Regulatory Risks

- Spectrum for mobile Broadband
- Antenna site sharing
- Interconnection costs/prices

Technology Risks

- Network compatibility
- Device availability
- Multi access
- Industry standards
- Collocated antennas

Market Risks

- Competition from existing fixed line and mobile operators
- Customers do not come
- Management of migration from/cannibalization of existing services,especially impact of VoIP

Sales Revenue

Transaction

Profit

?
?
?

Time

Environmental Risks

- Health & safety concerns
- Planning consent

Management & Organizational Risks

- Sufficient know how
- Lean, thus cost-effective organization

For each player there are opportunities and risks associated with MBWA … and fundamental questions that need to be answered

- ■ Incumbent fixed network operators need to assess the opportunities that MBWA provides, while protecting their current market position

- ■ Mobile operators need to assess the impact of MBWA on current 3G plans and decide whether MBWA is an attractive complementary option

- ■ New challengers and ISPs need to address the possibility of using MBWA to effectively free themselves from the incumbent-controlled local loop, and offer new broadband fixed and mobile services at reasonable prices

Interesting future …

…high impact …

high uncertainty