Business implications of mobile technology developments

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Structure

- Competitive landscape
- Access technologies
- Impact of IP
- Impact of storage
- Broadcasting technologies
- Conclusions



Key business indicators

	Subscription penetration, %	User penetration, %	ARPU US\$ / month	Traffic MOU / user
W Europe	102.0	79.5	44.2	212.4
C/E Europe	76.2	63.1	14.3	131.7
N. America	71.8	62.6	57.3	763.4
CALA	42.6	38.9	15.1	105.8
Asia Pacific	23.0	18.7	22.2	315.0
Mid East, Africa	21.5	18.9	20.5	166.4
Worldwide	34.8	29.0	28.5	287.2

CALA = Caribbean and Latin America

Source: Strategy Analytics 2006

Minutes of Use (MOU) for selected countries:

UK contract: 207 minutes / month (Strategy Analytics 2006) UK prepaid: 57 Spain contract: 188 Spain prepaid: 37 Germany contract: 103 Germany prepaid: 23 China: 311 (China Mobile 1H 2005) India: 367 (TRAI 3Q 2005) Japan: 150 (Japan Telecom Ministry) US: 760 (Vodafone data)

Barrier to market entry - CAPEX



Source: Stephens Inc. estimates, Wireless Week November 1, 2005

Market maturity and technologies



Evolving competitive landscape



MNO = mobile network operator MVNO = mobile virtual network operator FMC = fixed mobile convergence

Access technologies

- "3G" Evolution
- WiFi
- WiMAX



WCDMA roadmap



increasing speed & reducing production cost

HSDPA = high speed downlink packet access HSUPA = high speed uplink packet access WCDMA = wideband code division multiple access LTE = Long term evolution

CDMA roadmap



increasing speed and staying competitive

EV-DO = Evolution Data Optimize FL = Forward link RL = Reverse link

WiFi – Different forms of availability

- In office / home
- Hotspot
- Mesh networks
- Unlicensed Mobile Access (UMA)



WiFi mesh network trial - performance

- Peer-to-peer and User Terminal ("UT") to Access Point ("AP")
- Individual & simultaneous throughput
- Varying numbers of active UT's
- Throughput results:
 - Unloaded*, 80% of users to AP < 200kbps
 - Loaded^{**}, 80% of users to AP < 120kbps
 - Unloaded, 80% P-2-P user < 130kbps
 - Loaded, 80% P-2-P users < 45kbps
- Packet delay results:
 - Unloaded 20% of users to AP > 120 ms
 - Unloaded 10% saw delays of > 300 ms
 - Up to 7 fold increase for loaded network



*All nodes can relay, but not all nodes generating traffic

** All nodes can relay and all generating traffic

Source: Vodafone

WiMAX players

Both fixed wireless access and mobile wireless access players are involved

FIXED Wireless Access



MOBILE Wireless Access

WiMAX commercial status



Source: Vodafone, Siemens, Intel, Broadcom

FWA = fixed wireless access CPE = customer premises equipment

'Mobile' WiMAX coverage example

- WiMAX has no magic solution
- The cell ranges for 'mobile WiMAX' will be similar to 3G cell ranges as they are both targeting indoor coverage to portable users

Environment	Cell range
Dense Urban	300 m
Urban	500 m
Sub-urban	1-2 km
Rural	4-7 km

Assumptions:

2.1 GHz95% coverageUplink 128 kbps @ cell edge

Source: Alcatel: Assumes adaptive antenna system, 3dB turbo coding gain, using 3G frequencies

Lex: WiMAX

FT .com	FT MANCHEST	Business Education Report
	Subscription page	Sunday Feb 26 2006 . All times are London time.
Home World > Companies >	Lex	
Markets →	Lex: Wimax	
Market data 💦 🔸	Published: February 1 200)6 13:41 Last updated: February 1 2006 20:08
Managed funds		
Lex		Having broken investors' hearts and mobile companies'
About Lex		balance sheets, has 3G been in vain? An alternative
Investment navigator	AN AR	technology known as withax is graddaily making progress.
Best of Lex		Wimay comes in two flavours. This week the first equinment
Lex by email		set was certified for the fixed flavour known inelegantly, as
Your comments		802.16-2004. Fixed Wimax will mainly be used as an
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Comment & analysis →		wireless flavour, 802.16e. Unlike Wifi, the hotspot technology
Technology >	used in coffee shops v	vorldwide, mobile Wimax has a range measured in miles, not
Business life 💦 🕨	feet, and much faster s	peeds. Large trials have taken place in Korea, using a sister
Business education →	technology called Wibr	o. Intel, which is backing Wimax as its path into the broadband
Your money	wireless market, shoul	d have chips available by 2008.

Is mobile WiMAX a credible substitute for 3G? Probably not...

- Most 3G network are already upgrading to an adequate speed
- Spectrum is a problem
- Regional licenses
- Building a ubiquitous network would be far more expensive than buying wholesale 3G access

Can mobile WiMAX be giant hotspots? This threat cannot be totally ignored...

- Dual mode handsets are being developed
- 3G's potential inadequacies is evident by Qualcomm buying Flarion

The basic strategy of most mobile operators of being married to 3G, but being open mined about flings with other technologies, thus looks correct

Moving towards "all IP"

2004	2006		2010		
R99	R4	R5	R6	R8	
Separate CS and PS domains	CS Core over IP Split MSC	IP Multimedia Subsystem	Real Time		"All-IP"
CS voice, data up to 384 kbps		Push-to-Talk See What I See Presence, IM	VoIP Rich Call Gaming	 Aggressive IP to the ba Flatter archi Multi-accession 	performance target se station itecture s

- Benefits of moving to a standard architecture built around IP
 - Standard equipment lowers cost for carrying traffic
 - New set of vendors alters competitive dynamics reducing costs
 - New set of service functionality including lower maintenance

CS = circuit switched, PS = packet switched, VoIP = voice over Internet protocol, IM = instant messaging, IP = Internet protocol Vodafone © 2006 / IEEE ComSoc Oakland - East Bay

Evolving to a flat core network architecture

Notwork MSC Notwork RN Network p	GW* th protocols protocols C potocols DE / DNC / MEC SOEN / C	
Hierarchical	BS/RNC/MSC-SGSN/G	W Flat
	Incremental capacity scaling of central nodes	©
8	Cross technology interworking	 ©
8	Routing of user IP flows	
8	Mapping of QoS	
	High speed handoff / soft handoff	8
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;	Global radio resource management	8
e	Capital and recurring cost	
*GW = Gateway Node, e.g. P	DSN, GGSN BS=base stations, RNC=radio network controller, MSC=mobile switching center, S GGSN = GPRS Gateway Service Node, PDSN=Packet Data Service Node	SGSN=Serving GPRS Service Node,

Impact of VoIP

Important differences exist across telecoms:

- VoIP in fixed market
- VoIP in mobile enterprise market
- Mass-market consumer VoIP on mobiles





Media storage

- Storage technology is advancing rapidly in both performance and cost
- Fundamental to many new mobile services such as FTMD
- Also enables "non-networked mobility" business models such as iPod or PSP
- HDD currently higher capacity and cheaper/Mb than removable storage, but memory card is more convenient and cost/Mb is improving quickly



Memory card

Source: Vodafone



1-inch HDD & Compact Flash microdrive

Source: Seagate

FTMD = Full Track Music Download PSP = play station portable HDD = high density drive

Handset memory devices

- Driving multimedia revolution of handsets
- Many challenges
 - High capacities / densities
 - Small form factor
 - High read/write speed
 - Low power consumption
 - High reliability
 - Embedded or removable
 - Mechanical or solid state access
 - Low cost



Source: Vodafone, Sandisk





Mobile broadcasting

- Video streaming on WCDMA
- Drive for DVB-H in Europe
- MBMS, satellite, DMB, MediaFLO, TDTV as alternative broadcast approaches



Forecast suggest mobile TV to hit

MBMS = Multimedia broadcast multicast service, DMB = Digital mobile broadcast, DVB-H = Digital video broadcast – handheld, FLO = Forward link only

Mobile TV usage patterns will differ from

Summary

- HSPA / EVDO here in 2006 and developing quickly
- WiFi good private system but not for public-wide area service
- WiMAX probably too little, too late to be cost effective
- Coverage frequency bands still critical to cost of network
- VoIP coming slowly to mass market mobile
- Media storage a major agent of change
- Mobile broadcasting fragmented format battle or multi-format chip solutions

