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Working Party on Telecommunication and Information Services Policies

MOBILE MULTIPLE PLAY: NEW SERVICE PRICING AND POLICY IMPLICATIONS

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FOREWORD

This report was presented to the Working Party on Telecommunication and Information Services Policies in May 2006 and was declassified by the Committee for Information, Computer and Communications Policy in October 2006.

The report was prepared by Mr. Yoshikazu OKAMOTO of the OECD's Directorate for Science, Technology and Industry. It is published on the responsibility of the Secretary-General of the OECD.

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MAIN POINTS

This paper provides an overview of the evolution in mobile multiple play services (voice, data and video). The main findings in terms of market development are as follows:

- The mobile infrastructure is being upgraded as 3G network coverage expands and as mobile broadcasting networks are being developed. In addition, while mobility and portability has usually been considered the province of telephone networks only, communications service with mobility are now available (although not always with full mobility capabilities) through satellite networks, wireless local area networks (such as Wi-Fi), and through the use of advanced terminal equipment such as iPods and flash players.

- Almost all OECD countries have launched commercial 3G services.

- The global growth rate of 3G subscribers, although showing a slight downward trend during 2005, is expected to increase with the demand for data services in the near future.

- Approximately 30% of operators in OECD countries provide an option for 3G unlimited flat rate data services. Almost all operators provide both capacity-based and flat rate tariff plans in parallel.

- Roaming for 3G data services is limited usually to the region of the operator *i.e*. European operators tend to cover mainly European countries and North American operators tend to have roaming mainly in North America.

- In terms of the demand for 3G data services, Japan and Korea have been in the lead. High prices have been a disincentive to faster growth in 3G data services. Even flat rate 3G data services are relatively expensive.

- In parallel to the uptake of data services, video services are also being provided. These services are at present provided through 3G networks, but there are several experiments for new video services going on through mobiles utilising terrestrial and satellite broadcasting networks.

- The multiple play offers from fixed network providers and mobile multiple play offers are likely to converge as Fixed-Mobile Convergence services are developed. Initially fixed-mobile convergence will result in seamless fixed (sometimes fixed broadband)-mobile voice services and eventually evolve to seamless data and video services.

Some of the regulatory and policy issues raised in this paper are:

- Mobile Virtual Network Operators should be allowed since they can reduce entry barriers for specialised mobile data services and generate competition in this area, and in addition they will also play an important role especially in the context of fixed-mobile convergence.

- For firms, new technological developments such as fixed-mobile convergence may create new incentives for vertical and horizontal integration and disintegration. Regulatory oversight may remain necessary to monitor for anti-competitive behaviour at all levels of the value chain, including access to content and to networks.

- Technological upgrades, such as through HSDPA, will enable users to access large amounts of content which are similar to those on PCs. The issue of how to balance an open end-to-end connection for users while maintaining the integrity of the operator's network and quality of service will become important.

- In view of the fact that mobile TV services are new and innovative, it is important that regulators tread lightly, and delay imposing broadcasting type obligations such as the protection of the public, the promotion of cultural diversity and pluralism of the media until it is clearly determined that they are necessary.

1. INTRODUCTION

This document provides an overview of the evolution of multiple play in the mobile service sector (voice, data and video) focussing in particular on data services provided through 3G networks that have been launched in almost all OECD countries. Fixed-mobile convergence can also be viewed as one facet of mobile multiple play and will be touched on in this paper. The paper also assesses the competition from broadcast networks – both terrestrial and satellite, and from the development of advanced terminal equipment, such as iPods and flash players. Regulatory implications will also be examined in terms of access or behavioural issues. The paper complements earlier work by the OECD on multiple play by fixed or cable operators, and mobile voice prices.[1]

In the first half of the 1990s, more than 80% of mobile subscribers in the world were in OECD countries. However, as subscriber growth expanded outside the OECD area, OECD's share of total mobile subscribers declined to 54% by 2003.[2] In terms of supply, the mobile monopoly market structure in almost all the OECD countries in early 1990 was relatively rapidly overtaken by competitive market structures so that by 1998 almost all the OECD countries had three or four operators,[3] which has contributed to the spread of mobile phone services.

The development of market competition was accompanied, and facilitated, by changing mobile technologies moving from analogue infrastructures and services (1G) to the present third generation mobile services (3G). This process also resulted in a significant change in the capabilities of handsets allowing them to expand the range of services they provide.

The high levels of growth in mobile communications since the 1990s, which has led to a widespread market penetration of mobile services has also led users to increasingly substitute fixed line telephone services in favour of mobile services. In the OECD, mobile penetration overtook fixed line penetration in 2000 for the first time. Outside the OECD area the Baltic countries also followed this trend in 2001, and the BRIC countries in 2002.[4] Evidence shows that other emerging economies or developing countries where fixed line availability has grown slowly are increasingly shifting towards reliance on mobile communications over fixed lines.

The shift to 3G services has not been smooth compared to 2G as markets faced a number of stumbling blocks slowing down the deployment of these services. These included delays in handset availability, lack of capital financing to build-out networks as had been initially foreseen, partly in some cases because companies had paid high licence fees for 3G spectrum. In certain cases operators preferred to make the transition to 3G through supporting GPRS/EDGE services which provided higher speeds than 2G but not at

the speeds used to designate 3G services. In retrospect, it should be remembered that the passage to 2G took nearly 10 years.

In some countries 3G services started earlier. Korean operators started in May and October 2001, a Japanese operator started in October 2001. Asian operators focused on data transmission services using packet technology at an early stage in addition to voice services. For example, the Japanese operator NTT DoCoMo started its service, i-mode, which provides access to specific sites for mobile Internet access. In addition, in 2003, KDDI introduced a flat rate data plan for the first time in Japan, and its competitors were forced to follow suit. Nowadays a flat rate data service can be found in some OECD countries.

In Europe, Hutchison Telecom – 3 started 3G services in Italy and in the United Kingdom in 2003 and many operators have followed that trend. However, most customers are using SMS or MMS rather than other data services. Some operators are starting to provide an Internet access site specifically for their mobile services and the increase in data revenue reversed the long-term trend towards lower revenue per mobile user in 2003[5], but data access is not being viewed as a killer application at present.

In the United States, Verizon Wireless launched EV-DO technology in October 2003 and Sprint began rolling it out in July 2005. With EV-DO service, subscribers can access the Internet while mobile via a wireless modem card connected to a laptop computer or PDA, or they can download a range of multimedia content and advanced applications on certain mobile handset models. As with the EV-DO service offered by Verizon Wireless and Sprint Nextel, subscribers of Cingular, which started WCDMA with HSDPA based service in December 2005, could obtain the same kind of access service to the Internet.[6]

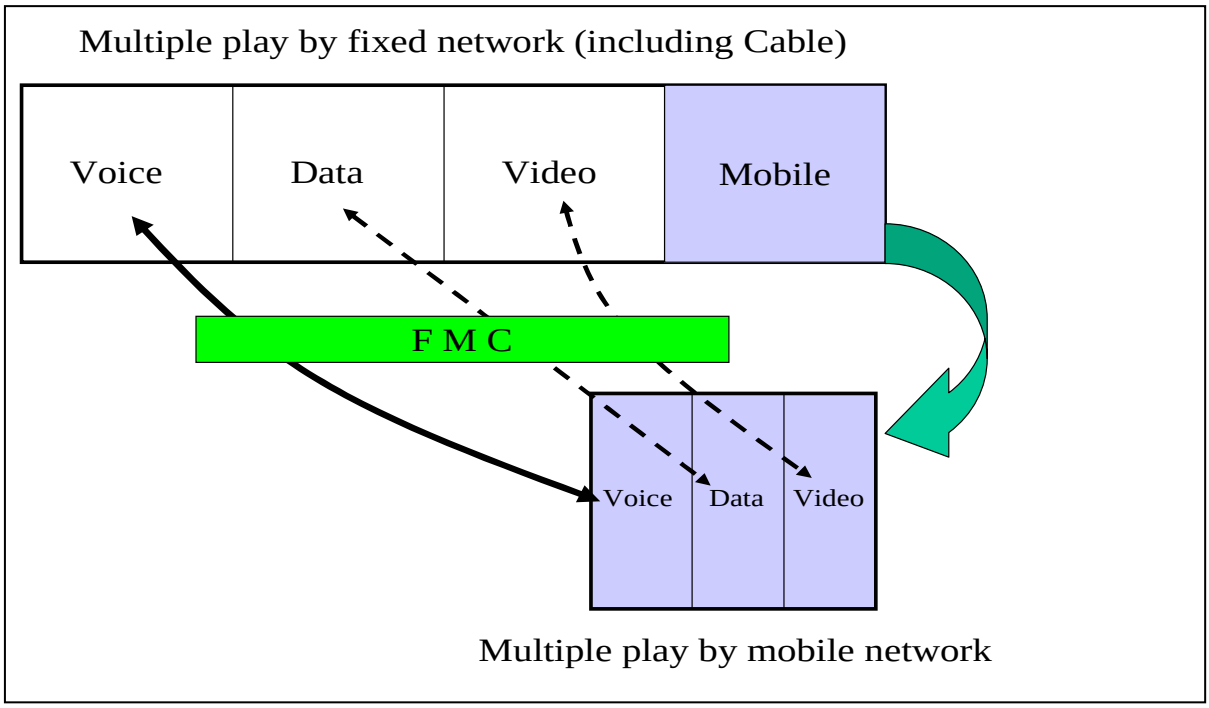
For mobile voice services, IP based services have been much slower in appearing on the market compared to fixed networks, one likely reason being that 3G was not designed for IP based services which consume more spectrum capacity than switched voice. However, wireless IP telephony is now being introduced. For example, the German 3G operator E-Plus announced a partnership with Skype which will enable Skype subscribers to call or use data services over E-Plus's mobile network.[7] Japanese operator WILLCOM has an alliance with Skype to equip their handsets with Skype software.[8] The Hutchison 3 Group has also announced an agreement to enable Skype communications on 3G.[9]

The traditional fixed telecommunications operators (some of which spun off their mobile sections) have started bundling services into so-called triple play services (voice, data, and video) and competing with cable network operators who are also providing triple play offers. Fixed and cable network operators are expanding their triple play offers into quadruple play to include mobile services. This is being done in order to combat the competitive threat from mobile services in taking fixed voice traffic and subscribers. The fixed operators are entering into alliances with mobile operators or creating Mobile Virtual Network Operators (MVNOs). Mobile operators are also thinking about offering multiple play services on their own networks, in particular, by providing video services in addition to voice and data. These services are at present provided through 3G networks, and by utilising broadcasting networks, including satellite networks. In addition, mobile operators are also examining how to offer fixed-mobile convergence (FMC) which is viewed as a key component in the near future. A number of new and emerging devices (flash players, music players, PDAs, etc.) which rely on fixed broadband networks to provide audiovisual and data content, but which increasingly are becoming capable to connect to Wi-Fi networks and are integrating VoIP, may also play a role in the future. In addition, the expansion in the number of Wi-Fi networks and WiMax networks which may provide competition to 3G networks in providing high-speed Internet access in the future may also play an important role in the process of fixed-mobile convergence.

In the future it is expected that all wire and radio communications will converge with Next Generation Networks (NGN). Mobile services will be one of the multiple play services provided by fixed networks on

the one hand and mobile networks will also provide separately multiple play services on the other (shaded boxes in Figure 1.). As fixed mobile convergence develops, voice services using the fixed network and using mobile networks become interrelated (bold arrow). This merging of networks and services will occur for data and video in the near future (dotted arrows), although it will require some technological upgrading to realise this.

Figure 1. Nesting boxes between fixed and mobile networks



2. Technological aspects of infrastructure

IMT-2000 (International Mobile Telecommunications-2000) consists of five standards which were defined by the ITU and have become commonly known as 3G mobile, the details and characteristics of which were introduced in the 'Developments of Third-Generation Mobile Services in the OECD' (DSTI/ICCP/TISP(2003)10/FINAL). In summary, these IMT-2000 technologies are: Wideband CDMA (WCDMA), CDMA multi carrier (MC) including 1X and 3X, CDMA TDD including both the 1.28 Mchip/s TDD (or TD-SCDMA) and 3.84 Mchip/s TDD, TDMA - single carrier providing an evolution path to both a GSM/GPRS based and the TIA/EIA-41 US based systems, and finally FDMA/TDMA technology with radio interface known as digital enhanced cordless telecommunications (DECT).[10]

Some new standards have been developed. These include HSDPA and TD-SCDMA. HSDPA is an evolution of the IMT-2000 WCDMA standard and has been deployed in Japan, Korea, the United States and in several European countries. TD-SCDMA is presently being examined by China. TDtv, focusing on mobile TV services through 3G networks, has also been developed.

2-1. Latest technologies for 3G networks

a) HSDPA (High-Speed Downlink Packet Access)

HSDPA is an evolution of the W-CDMA standard, designed to increase the available data rate to a maximum of 14.4 Mbps and defines a new W-CDMA channel, the high-speed downlink shared channel

(HS-DSCH) which provides the possibility to time-multiplex different users, improving the channel re-allocation time.[11] The technical specifications were developed by 3GPP (the 3rd Generation Partnership Project) Release 5.

b) TD-SCDMA (Time Division-Synchronous Code Division Multiple Access)

TD-SCDMA has been examined by China in an attempt to develop a home-grown technology. It uses TDD (Time division duplex) which allows adaptive allocation of radio resources. Since all CDMA users share the same frequency channel, each CDMA user interferes with all the others, but TD-SCDMA with its 16 codes can implement joint detection which limits multiple access interference. In addition, transmission and reception of signals is directed to and from the specific terminals instead of power being distributed over the whole cell. With this smart antenna technology, inter-cell interference in all adjacent cells using the same radio frequency carrier can be avoided.[12] The Chinese government will award 3G licences to mobile operators in China and a TD-SCDMA based licence is supposed to be included.

c) 3G LTE (Long Term Evolution)

The specification for 3G LTE, sometimes inaccurately called 4G, is based on 3G release 7 (OFDM and MIMO) and will be finalised in 2007, for deployment between 2008 and 2015. It will allow rates up to 100 Mbps on the downlink in a 20 MHz radio channel bandwidth.

d) TDtv

TDtv is a technology developed by IPWireless, which is based on the 3G MBMS (Multimedia Broadcast Multicast Services) standard and adapts the standardised UMTS TD-CDMA technology, to utilise the existing unpaired 3G network (1900 MHz and 2010 MHz 3G spectrum bands). IPWireless claims that operators can run 50 TV channels for standard screen size phones or 15 higher quality QVGA (Quarter Video Graphics Array) channels in 5MHz of unpaired 3G spectrum. With the MBMS, an unlimited number of subscribers can watch the same channel or use the same network bandwidth.[13] Most operators have 2 classes of frequency, paired and unpaired, with the paired being reserved for 2-way services such as voice and data. The unpaired is used for asymmetrical services such as data, but is mostly unused.[14] In most countries, the unpaired spectrum is sold with the 3G spectrum. Australia is one of the few cases to licence it separately.[15]

Box 1. MBMS (Multimedia Broadcast Multicast Services)

TDtv is basically different from services based on broadcasting spectrum because the 3G network was not originally constructed for TV broadcasting. With a 3G network, if 10 users in the same cell want to see the same programme, it has to be transmitted 10 times, rather than once as for broadcasting. The solution to saving spectrum is MBMS utilizing a broadcast or multicast mechanism to send the same programme to active mobile handsets. MBMS does not require additional spectrum because it utilises existing 3G networks and as such, requires little additional investment for upgrading network equipment such as base stations.

Spectrum for MBMS is limited to 5 MHz and needs to share bandwidth with voice or data. In this regard, the speed for video services cannot compete with other mobile broadcasting technologies. It is at most 384 kbits per second and equivalent to three channels coded with a low resolution (128 kbits per second).

MBMS can provide two types of services: broadcast and multicast. The former distributes content to all users in the same cell. This suits a business model where broadcasters pay for the distribution of content. With a multicast business model, content distribution is provided to a limited number of users in the same cell. This type is appropriate for subscription based services such as weather news.

Some people expect that MBMS will be the global standard in that it can function wherever 3G exists, but others suspect that it will falter when broadcasting standard technologies arrive on the market.[16]

Main source: Daniel BOUDET de MONTPLAISIR (2005) '*Télévision Numérique Et Mobilité - Rapport Établi À La Demande Du Premier Ministre*' at: http://www.Ddm.Gouv.Fr/IMG/Pdf/Boudet_Tvmobile-5.Pdf: 15-16.

2-2. Technologies for mobile TV (or radio) services based on broadcasting networks

a) DVB-H (Digital Video Broadcasting - Handhelds)

The Digital Video Broadcasting (DVB) Project is an industry-led consortium of over 270 broadcasters, manufacturers, network operators, software developers, regulatory bodies and others in over 35 countries.[17] They provide a range of digital video transmission standards: DVB-S for Satellite, DVB-C for Cable television, DVB-T for terrestrial broadcasting and DVB-H which is specifically for mobiles. The DVB-H standard was selected by ETSI (The European Telecommunications Standards Institute) as the European mobile TV standard.[18] One of the key benefits of DVB-H is its process which is known as 'time slicing' that helps preserve battery life on a device by switching on only at particular intervals. DVB-T has already rolled out in Europe and it can be inter-operable easily with DVB-H.

b) T-DMB (Terrestrial - Digital Multimedia Broadcasting)

T-DMB was developed in Korea and was approved for terrestrial transmission by ETSI and WorldDAB. The core technology of T-DMB is Eureka-147 Digital Audio Broadcasting (DAB) with additional error correction and DAB is already popular in Europe particularly in Germany and in the United Kingdom, where T-DMB technology is familiar. T-DMB is backward compatible with Eureka-147 DAB networks, so it is possible to use existing DAB networks and frequencies for T-DMB service. Commercial service of T-DMB was launched in December 2005 in Korea, and various types of terminals have already been released. The 3D service and the data rate improving technologies for T-DMB are under development.

c) MediaFLO

MediaFLO is an end-to-end mobile multimedia broadcast system based on FLO (Forward Link Only) a new, orthogonal frequency division multiplexing (OFDM) - radio access technology designed from the ground-up for the simultaneous delivery of large volume of rich multimedia content in a cost efficient way to multiple wireless subscribers. It takes advantage of well-known broadcast technical principles in a single-frequency network, therefore significantly reducing the cost of delivering identical content to numerous users simultaneously in a spectrally efficient manner. Development and endorsement of MediaFLO is supported by the FLO Forum (www.floforum.org), an international organisation responsible for driving the global standardisation and industry endorsement of the technology. More than 60 leading wireless and broadcasting industry companies from around the world participate in the FLO Forum to ensure that MediaFLO is being made open and available to a wide range of technology providers, equipment and handset manufacturers as well as wireless carriers and broadcasters.

Table 1. Comparison of DVB-H, T-DMB and MediaFLO

	DVB-H	T-DMB	MediaFLO
Advantages	• Open standard with wide-backing from the wireless industry, particularly in Europe; supported by the US-based DVB-H Alliance, whose founding members include Nokia, Motorola, Microsoft, Intel and Texas Instruments. Additionally, this technology is currently being deployed at 1670-1675 MHz nationwide across the US and there are plans to commercially test at 700 MHz this year. • Maximum data rate of 15 Mbps in 5-8 MHz of bandwidth down to 5 Mbps if robust reception is required • Time-slicing helps conserve battery power since the receiver is only on when viewing the channel of interest • While DVB-H can be transmitted on a dedicated channel, it is designed to share a multiplex with DVB-T and can take advantage of the hierarchical transmission capability of DVB-T	• Open standard with wide backing from the wireless industry in Asia and DAB community in Europe • Band III and L-Band frequencies are already set aside for DAB, so DMB could take advantage of these where available with little legislation • Time Division Multiplexing delivery inherent in DMB transmits specific content at specific time intervals which allows the receiver to be shut down in between these intervals to save power • Channel switching time of about 1.5 seconds on current T-DMB devices • With Band III, possible to get the wide coverage area • Possible to use the existing DAB network and frequencies for T-DMB service	• Standardised in TIA and specified in an industry forum (FLO forum) comprising more than 60 international telecommunications and broadcast industry leaders • Average channel switching time of 1.5 seconds • Supports up to 30 real-time video plus audio streaming channels at OVGA, 30 fps in a 8 mHz bandwidth • Simultaneously optimises power consumption, frequency diversity, and time diversity without compromising any of these parameters • Uses efficient error correction techniques, such as turbocodes • Utilises layered hierarchical modulation techniques with layered source coding in order to offer a robust signal reception even in poor coverage areas • Designed to support multiple spectrum range (*e.g.* UHF, L-Band, etc.) and frequency bandwidth (5, 6, 7, 8 mHz) both in Single Frequency Network and Multiple Frequency Network Configuration

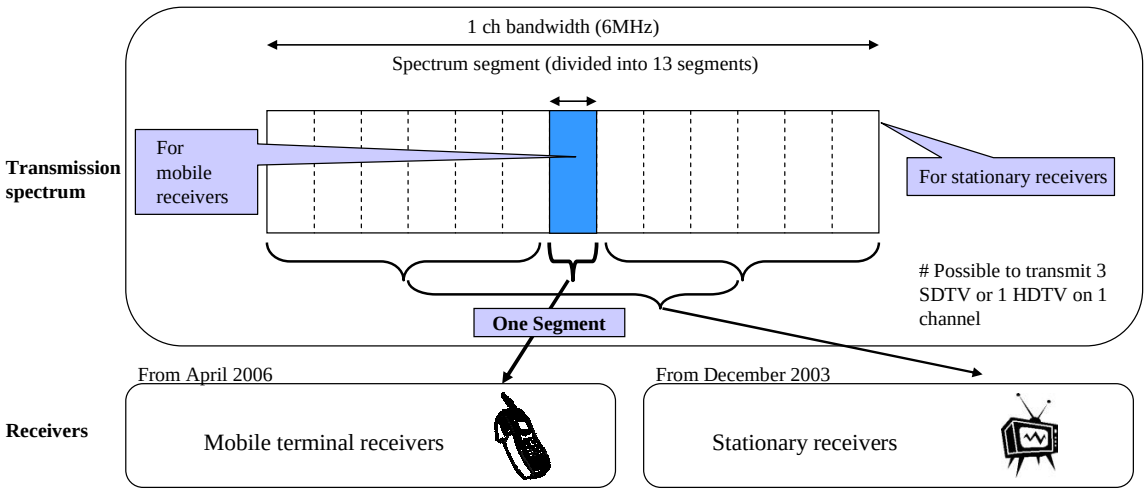
Disadvan-tages	• UHF frequencies (470-860 MHz) are ideal for DVB-H but these are tied up with analogue TV transmissions — other frequency bands can also be used	• The L-Band frequencies (1452-1467.5 MHz) already set aside for DAB require a much higher density of transmitters to provide adequate coverage — and scaling up for large amounts of services would require additional frequency allocation • The UK and others adopting DAB have rolled out digital radio in band III (around 221 MHz) which could mean large antennas strapped to their DMB enabled cell phones, should these countries choose to ride their DMB broadcasts on top of DAB transmissions • Maximum data rate of 1.152 Mbps in about 1.5 MHz of bandwidth (The technology to improve data rate is under development)	• Potential regulatory restrictions may limit the introduction and the cost efficient deployment of mobile broadcast networks. • Designed to work in bands from 450 MHz to 3 GHz, some of which is currently allocated to analogue television broadcasts. Countries other than the U.S., would have to assign spectrum to accommodate other services. • In the U.S., the band 698 – 806 MHz is allocated for fixed, mobile and mobile broadcasting services. Both DVB-H and MediaFLO technologies are planned to be deployed in this band by Aloha/HiWire and Qualcomm, respectively.

Main source: http://www.engadget.com/2006/01/17/digital-television-part-1-making-sense-of-it-all/.

d) ISDB-T (Integrated Services Digital Broadcasting-Terrestrial)

ISDB was developed in Japan and mobile digital terrestrial TV services based on this called One-Seg started in April 2006. Programmes for stationary and mobile receivers can be transmitted in the same spectrum: ISDB-T has the capacity for segmentation of a channel and various applications; for example, 1 HDTV (12 segments) together with mobile service (1 segment), or 3 SDTV (3 x 4 segments) with mobile service (1 segment) can be transmitted at the same time.

Figure 2. One-Seg broadcasting in Japan



Source: Ministry of Internal Affairs and Communications, Japan.

e) Movio

BT's product, Movio, with Virgin Mobile currently uses the DAB (Digital Audio Broadcasting) standards. It uses Internet technology and the digital radio spectrum (in part owned by Digital One, the UK national digital broadcaster controlled by GCap Media and Arqiva) to simulcast live TV to DAB-IP enabled smart-phones. BT is aiming to be the first wholesale mobile broadcast entertainment service enabling mobile operators to provide their own branded service. The launch of the service is comparatively easy in that the network is already in place across the country.[19]

f) S-DMB (Satellite – Digital Multimedia Broadcasting)

S-DMB has been used in Korea and Japan. S-DMB's satellite transmission technology is used by SK Telecom, Korea's largest mobile network and services started in May 2005. S-DMB service was also available in Japan via the same satellite through a partnership with a Japanese consortium of companies.[20]

g) Satellite Digital Audio Radio Service (SDARS)

SDARS uses satellites operating in the 2.3 GHz frequency band to provide continuous nationwide radio programming with compact disc quality sound. Its services are widespread especially in the United States. In the United States, Sirius Satellite Radio and XM Radio were authorized to launch and operate satellites to provide SDARS in 1997. In Canada, XM Radio of the United States was licensed because construction of a SDARS satellite fleet dedicated to the Canadian domestic market would be expensive, and no existing or planned Canadian space facilities could be adapted for SDARS service.[21]

3. Commercial 3G services

The ITU defined a global standard for 3G, IMT-2000 (International Mobile Telecommunications-2000), which consists of five standards; in today's market the W-CDMA and CDMA2000 standards are most common in the OECD countries. The following table indicates 3G commercial service operators based on technologies such as W-CDMA, W-CDMA/HSDPA, CDMA2000 1x, CDMA2000 1xEV-DO.

Table 2. 3G commercial service operators in the OECD countries (as of February 2006)

Country	Operator	Service-in date (d/m/y)	Technologies
Australia	Vodafone	01-11-2005	WCDMA
	Telstra	16-11-2004	CDMA2000 1xEV-DO
	Telstra	02-12-2002	CDMA2000 1X
	Hutchison Telecom - 3	18-08-2004	CDMA2000 1X
	Hutchison Telecom - 3	15-04-2003	WCDMA
Austria	Mobilkom	23-01-2006	HSDPA
	Mobilkom	25-04-2003	WCDMA
	T-Mobile	10-05-2004	WCDMA
	tele.ring	19-02-2004	WCDMA
	Connect-One	20-12-2003	WCDMA
	Hutchison Telecom - 3	05-05-2003	WCDMA
Belgium	Belgacom Mobile S.A. (Proximus)	01-05-2004	WCDMA
Canada	Bell Mobility	31-10-2005	CDMA2000 1xEV-DO
	Bell Mobility	12-02-2002	CDMA2000 1X
	SaskTel Mobility	10-04-2003	CDMA2000 1X
	MTS Mobility	27-11-2002	CDMA2000 1X
	Aliant Inc.	25-11-2002	CDMA2000 1X
	Telus Mobility	14-11-2005	CDMA2000 1xEV-DO
	Telus Mobility	03-06-2002	CDMA2000 1X
Czech Rep.	T-mobile	19-10-2005	WCDMA
	Eurotel	01-12-2005	WCDMA
	Eurotel	02-08-2004	CDMA2000 1xEV-DO
Denmark	TDC mobile	04-11-2005	WCDMA
	Hutchison Telecom - 3	13-10-2003	WCDMA
Finland	DNA Finland Oy	19-12-2005	WCDMA
	Elisa	23-11-2004	WCDMA
	Sonera	13-10-2004	WCDMA
France	Orange	07-09-2004	WCDMA
	SFR	16-06-2004	WCDMA
Germany	O2	01-07-2004	WCDMA
	E-Plus	18-06-2004	WCDMA
	T-Mobile	05-05-2004	WCDMA
	Vodafone	04-05-2004	WCDMA
Greece	Cosmote	26-05-2004	WCDMA
	TIM-STET Hellas	27-01-2004	WCDMA
	Vodafone-Panafon	23-01-2004	WCDMA
Hungary	T-mobile	26-08-2005	WCDMA
Iceland	No Provision		
Ireland	O2 Ireland	01-09-2005	WCDMA
	Hutchison Telecom - 3	26-07-2005	WCDMA
	Vodafone	29-06-2004	WCDMA
Italy	Wind	25-10-2004	WCDMA
	TIM-Telefonica Italia Moviles	24-05-2004	WCDMA
	Vodafone	25-03-2004	WCDMA
	Hutchison Telecom - 3	03-03-2003	WCDMA

Country	Operator	Service-in date (d/m/y)	Technologies
Japan	KDDI	01-10-2003	CDMA2000 1xEV-DO
	KDDI	01-04-2002	CDMA2000 1X
	Vodafone K.K.	20-12-2002	WCDMA
	NTT DoCoMo	01-10-2001	WCDMA
Korea	KTF	01-01-2004	WCDMA
	KTF	05-08-2002	CDMA2000 1xEV-DO
	KTF	01-05-2001	CDMA2000 1X
	SK Telecom	01-01-2004	WCDMA
	SK Telecom	28-01-2002	CDMA2000 1xEV-DO
	SK Telecom	01-10-2000	CDMA2000 1X
	LG Telecom	01-05-2001	CDMA2000 1X
Luxembourg	No Provision		
Mexico	Iusacell	14-07-2004	CDMA2000 1X
	Unefon	24-01-2004	CDMA2000 1X
Netherlands	KPN	11-10-2004	WCDMA
	Vodafone	16-06-2004	WCDMA
New Zealand	Telecom New Zealand	08-11-2004	CDMA2000 1xEV-DO
	Telecom New Zealand	22-07-2002	CDMA2000 1X
Norway	NetCom	01-06-2005	WCDMA
	Telenor Mobil	01-12-2004	WCDMA
Poland	PTC-EraGSM	25-11-2004	WCDMA
	Polkomtel-PlusGSM	06-09-2004	WCDMA
Portugal	Optimus	03-06-2004	WCDMA
	Vodafone	04-05-2004	WCDMA
	TMN-Portugal Telecom	21-04-2004	WCDMA
Slovak Rep.	No Provision		
Spain	Amena	01-11-2004	WCDMA
	Vodafone	25-05-2004	WCDMA
	Telefonica	24-05-2004	WCDMA
Sweden	Tele2 AB-Comviq	01-06-2004	WCDMA
	TeliaSonera	10-03-2004	WCDMA
	Vodafone	23-02-2004	WCDMA
	Hutchison Telecom - 3	05-05-2003	WCDMA
Switzerland	Orange Swiss	05-09-2005	WCDMA
	Swisscom	09-09-2004	WCDMA
Turkey	No Provision		
United Kingdom.	Manx Telecom	01-11-2005	HSDPA
	O2	01-02-2005	WCDMA
	Orange	19-07-2004	WCDMA
	Vodafone	02-04-2004	WCDMA
	T-Mobile	16-02-2004	WCDMA
	Hutchison Telecom - 3	03-03-2003	WCDMA
United States	Mobile ESPN (MVNO)	05-02-2006	CDMA2000 1xEV-DO
	Mobile ESPN (MVNO)	05-02-2006	CDMA2000 1X
	amp'd mobile (MVNO)	15-12-2005	CDMA2000 1xEV-DO

Country	Operator	Service-in date (d/m/y)	Technologies
	amp'd mobile (MVNO)	15-12-2005	CDMA2000 1X
	Cingular-AT&T Wireless	06-12-2005	HSDPA
	Cingular-AT&T Wireless	20-07-2004	WCDMA
	Sprint-Nextel	07-07-2005	CDMA2000 1xEV-DO
	Sprint-Nextel	11-08-2002	CDMA2000 1X
	Midwest Wireless	21-04-2005	CDMA2000 1xEV-DO
	Midwest Wireless	16-06-2003	CDMA2000 1X
	Alltel	29-03-2005	CDMA2000 1xEV-DO
	Alltel	03-01-2003	CDMA2000 1X
	ClearTalk-NTCH Inc	15-12-2004	CDMA2000 1X
	ACS-Alaska Communications Systems	15-06-2004	CDMA2000 1xEV-DO
	ACS-Alaska Communications Systems	24-05-2004	CDMA2000 1X
	Carolina West Wireless	29-04-2004	CDMA2000 1X
	Illinois Valley Cellular	01-04-2004	CDMA2000 1X
	Northcoast PCS	09-03-2004	CDMA2000 1X
	Rural Cellular	31-12-2003	CDMA2000 1X
	Verizon Wireless	01-10-2003	CDMA2000 1xEV-DO
	Verizon Wireless	28-01-2002	CDMA2000 1X
	Kiwi PCS	14-11-2002	CDMA2000 1X
	US Cellular	12-11-2002	CDMA2000 1X
	Cellular South	09-09-2002	CDMA2000 1X
	nTelos	06-05-2002	CDMA2000 1X
	MetroPCS	01-02-2002	CDMA2000 1X
	Leap Wireless-Cricket	10-12-2001	CDMA2000 1X

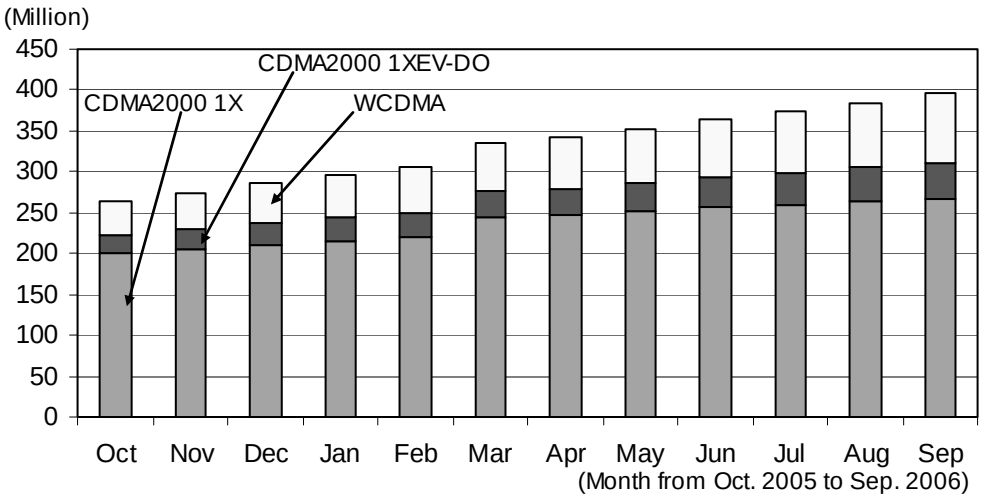
Source: 3G Today, OECD.

Note: US operators are only on the mainland.

The launch of commercial 3G services was slow in many European countries, but almost all OECD countries now have several operators providing 3G services.

The number of 3G subscribers is gradually increasing and most of the subscriptions stem from CDMA2000 1X, followed by W-CDMA and CDMA2000 1x EV-DO (See Figure 3.). As of September 2006, there were approximately 395 million 3G subscribers worldwide. As of January 2006, Japan accounted for approximately 15% of these subscribers, followed by Korea with approximately 13%.[22] The number of 3G subscribers globally in December 2003 was 99.6 million[23] accounting for 7.2% of the world's total mobile subscribers.[24]

Figure 3. The number of 3G CDMA subscribers

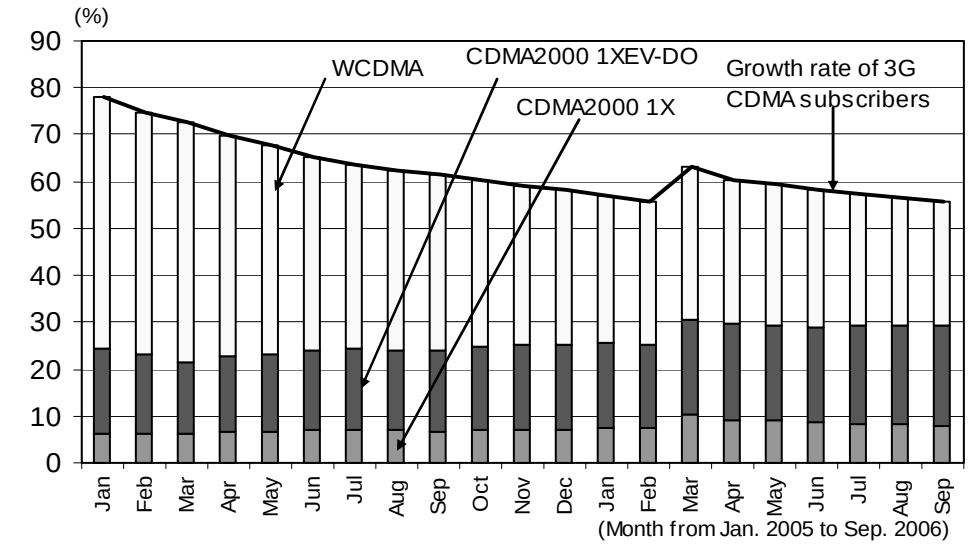


Source: 3G Today.

Note: As of 31October 2006, 232 operators provide commercial 3G services using CDMA2000 or W-CDMA technologies. The above figure sums up 170 operators whose data are available.

In terms of the year-on-year base growth rate of 3G CDMA subscribers, Figure 4 shows a declining trend from 2005 to present. The most important contributory factor to the growth of 3G CDMA subscribers was W-CDMA based subscriptions, followed by CDMA2000 1XEV-DO and CDMA2000 1X subscriptions. W-CDMA based subscriptions represented more than half of the growth rate every month during 2005. This was partly because many operators adopting W-CDMA technology especially in Europe started their services in 2004.

Figure 4. The contribution rates of each technology to the year-on-year growth rate of 3G CDMA subscribers



Source: OECD, 3G Today.

However, the declining trend in 3G CDMA subscriptions is not likely to continue but rather reflects the transition phase the service is in. For example, at present 3G network coverage is not sufficient in some countries to handle calls from moving vehicles which easily go beyond the range of the network. However, predictions, as for example from Forrester Research, indicate that GSM-only phones will fade out quickly within the next two years. GPRS will dominate for the rest of the decade but 60% of Europeans will own 3G mobiles by the end of 2010.[25] There is also an indication that judging from the renewal cycle, the people buying a GPRS phone now are more likely to buy 3G in two years' time.[26] Manufacturers such as Nokia also anticipate faster diffusion of 3G and regard its devices as a mainstream of their production.[27]

HSDPA technology is closely related to mobile data or video services as well as voice services, so many countries are starting to examine its feasibility. For example, Eurotel of the Czech Republic, which was the first operator in Europe to offer CDMA2000 1xEV-DO based services, is testing HSDPA with Nokia.[28] Orange of France, finished testing its new networks based on HSDPA, and is now offering it as 3G+, with roaming access from 13 countries and bit rate up to 1.8 Mbit/s (as of September 2006). NTT DoCoMo of Japan has finished developing handsets based on HSDPA and its commercial service is supposed to start in July 2006.[29] KPN of the Netherlands has expressed its intention to cover 80% of the population (now 70%) with its W-CDMA based network and to upgrade it to HSDPA based one.[30] In Germany T-mobile has also indicated that it will launch HSDPA networks in Germany, Austria and the Netherlands in the first quarter of 2006, and that it also plans to start HSDPA in the United Kingdom in late 2006.[31] Manufacturers are also paying attention to HSDPA products, and HSDPA support devices have reportedly doubled the production figures of the past six months.[32]

4. 3G Data services

In this section, data services provided by some operators in the OECD are compared. An overview is given of the method used to collect data, especially for data service prices, and then data service prices as of March 2006 are compared. At the same time, data services availability in other countries; *i.e.* international roaming is covered. Second, the method of classification of data services and its implications is discussed although this is made difficult by the fact that the form and content of service provision varies from country to country.

4-1. Data collection

4-1-1. Tariffs of data services

For each OECD country data from two operators were collected. Those operators in most cases hold the first and second largest market share. However, if only one operator provided 3G services in a country, such a comparison could not be done. From the countries surveyed only the United States had three operators. The number of operators there is large compared with other countries with two RBOC (Regional Bell Operating Companies) based mobile operators.

The data for comparison used is 'additional data' rather than 'endowed data in a package'. Almost all operators offer a monthly packaged plan which includes an amount of data, but the price of the package or data amount differs from operator to operator. Therefore, to be consistent, this paper will focus on additional data tariffs per MB. Operators normally provide various plans for consumers to choose from, and the least expensive additional data prices have been chosen here.

Table 3. 3G 'additional data' prices for private users

Country	Operator	Price USD (PPP)	Flat rate service availability
Per MB			
Portugal	TMN-Portugal Telecom	0.07	N
Portugal	Vodafone	0.07	N
Finland	Elisa	0.16	N
Sweden	Tele2 AB-Comviq	0.16	N
Australia	Telstra	0.18	N
Hungary	Pannon	0.20	N
Australia	Hutchison Telecom - 3	0.21	N
Austria	T-Mobile	0.22	Y
Switzerland	Swisscom	0.28	N
Netherlands	KPN	0.33	N
New Zealand	Telecom New Zealand	0.35	N
Denmark	Hutchison Telecom - 3	0.43	Y
Denmark	TDC	0.43	N
Austria	Mobilkom	0.55	N
Germany	Vodafone	0.63	N
Spain	Telefonica	0.77	N
Hungary	T-mobile	0.78	N
Japan	KDDI	0.88	Y
Japan	NTT DoCoMo	0.88	Y
U.K.	Orange	0.95	N
Germany	T-Mobile	1.09	N
Greece	Cosmote	1.14	N
U.K.	T-Mobile	1.20	Y
Finland	Sonera	1.45	N
Ireland	O2 Ireland	1.67	N
Belgium	Belgacom Mobile S.A. (Proximus)	2.04	N
Norway	Netcom	2.07	N
Norway	Telenor Mobil	2.07	N
Ireland	Vodafone	2.32	N
Greece	Vodafone-Panafon	2.47	N
Slovak Rep.	T-Mobile	2.57	Y
Korea	KTF	2.70	Y
Korea	SK Telecom	4.05	N
Canada	Bell Mobility	5.56	Y
Poland	Polkomtel-PlusGSM	6.23	N
Poland	PTC-EraGSM	6.23	N
Italy	TIM-Telefonica Italia Moviles	7.02	N
Italy	Vodafone	7.19	N
Mexico	Unefon	7.80	N
Mexico	Iusacell	14.04	Y
Per minute (*)			
France	SFR	0.38	N

Note: (*) Only SFR of France does not use a volume based tariff.

Table 4. 3G 'additional data' prices only for corporate users (per MB)

Country	Operator	Price USD (PPP)	Flat rate service availability
Sweden	Vodafone	0.14	N
Netherlands	Vodafone	0.33	N
Switzerland	Orange Swiss	0.69	N
Spain	Vodafone	0.75	N
US	Sprint-Nextel	1.08	Y
US	Cingular-AT&T Wireless	2.19	Y
Canada	Telus Mobility	4.63	Y

Note: As of October 2006, Orange France is offering 'Orange Business Services'.

Table 5. 3G flat data service prices (per month)

Country	Operator	Price USD (PPP)	Flat rate service only
Korea	KTF	13.18	
Japan	NTT DoCoMo	27.79	
Japan	KDDI	29.92	
Czech Rep.	Eurotel	54.97	Y
Slovak Rep.	T-Mobile	63.72	
Austria	T-Mobile	66.22	
Czech Rep.	T-mobile	67.67	Y
Denmark	Hutchison Telecom - 3	72.29	
France	Orange	76.67	Y (1)
US	Sprint-Nextel (3)(4)	83.99	
US	Verizon Wireless (4)	84.79	Y
US	Cingular-AT&T Wireless (3)(4)	85.59	
Canada	Telus Mobility (3)	92.67	
Canada	Bell Mobility	92.67	
Mexico	Iusacell	228.34	
UK	T-Mobile	N/A (2)	

Notes: 1) Orange provides a 3 hours or 10 hours option other than an unlimited usage but it does not provide 'additional' prices, therefore the unlimited usage has been chosen in this case. (As of October 2006, Orange is offering 3G flat VPN data services.)
2) The availability of service was based on the information from news articles.
3) Those services are for corporate users.
4) If a subscriber also takes a voice plan the price is USD 59.99 (plus tax) per month, but the price for a stand alone data service is USD 79.99 (plus tax).

4-1-2. International data roaming

Voice and data will remain an important part of mobile services even as multiple play becomes more widespread in the mobile area. In this context the ability to use these services outside a home country (roaming) will also be important. The number of countries in which international 3G data roaming services are available at present is shown in Table 6. Although international roaming prices are critical in determining the use of data services in other countries these prices are not covered in this paper. Where data were not available on 3G data roaming, non-3G roaming such as GPRS has been used as a proxy.

Table 6. The number of countries with which international 3G data roaming services are available

Country	Operator	Number of countries
Japan	NTT DoCoMo	64
Austria	Mobilkom	30
Poland	PTC-EraGSM	30
Norway	Telenor Mobil	28
Switzerland	Swisscom	25
Austria	T-Mobile	24
Spain	Vodafone	24
Denmark	Hutchison Telecom - 3	21
Finland	Sonera	21
Germany	T-Mobile	20
Netherlands	Vodafone	20
Poland	Polkomtel-PlusGSM	20
Finland	Elisa	19
France	Orange	19
France	SFR	18
Greece	Vodafone-Panafon	18
UK	Orange	18
Belgium	Belgacom Mobile S.A. (Proximus)	17
Denmark	TDC	17
Australia	Hutchison Telecom - 3	16
Germany	Vodafone	15
Hungary	T-mobile	15
US	Verizon Wireless	13
Greece	Cosmote	11
Japan	KDDI	11
Ireland	Vodafone	10
Switzerland	Orange Swiss	10
Korea	SK Telecom	9
Sweden	Tele2 AB-Comviq	9
Australia	Telstra	8
Italy	Vodafone	8
Netherlands	KPN	8
Slovak Rep.	T-Mobile	7
Mexico	Unefon	2
New Zealand	Telecom New Zealand	2
Norway	Netcom	2
Canada	Telus Mobility	1
Canada	Bell Mobility	1

Country	Operator	Number of countries
Portugal	Vodafone	1
US	Sprint-Nextel	1
Hungary	Pannon	0
Italy	TIM-Telefonica Italia Moviles	0
Mexico	Iusacell	0
Portugal	TMN-Portugal Telecom	0
Sweden	Vodafone	0
UK	T-Mobile	N/A

Table 7. The number of countries with which international non-3G data roaming services are available

Country	Operator	Number of countries
U.S.	Cingular-AT&T Wireless	95
Korea	KTF	80
Ireland	O2 Ireland	78
Spain	Telefonica	74
Czech Rep.	T-mobile	52
Czech Rep.	Eurotel	30

4-2. Classification of data services

Generally speaking, methods of data service classification are as follows:

- Connection patterns (direct or indirect)
- Distinction between private and corporate usages
- Flat rate or non-flat rate (packaged plan or occasional usage plan in the case of non-flat rate)

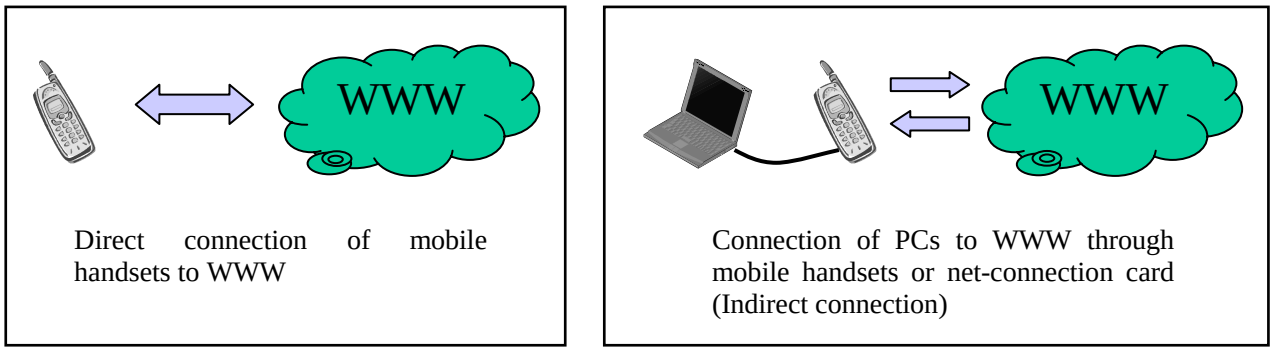
4-2-1. Connection patterns

Connection patterns between mobile handsets and Internet are divided mainly into two: one is the direct connection of mobile handsets to Internet, and the other is the connection of PCs to Internet by mobile handsets or net-connection cards (See Figure 5).

In some countries such as Japan which introduced i-mode, 2G was also used for data services and mobile handsets were directly connected to Internet. Other operators also provided different forms of Internet access *e.g.* through WAP in Europe. However, unlike i-mode, access to the Internet using WAP has never taken off whereas SMS services were highly successful. As 3G services were introduced, operators have been providing data services indirectly through handsets or sometimes with net-connection cards. Nowadays, there are some cases in which 3G operators are providing data services directly through mobile handsets. Some operators have introduced Japanese i-mode such as Telstra of Australia, E-plus of Germany, Cosmote of Greece, O2 of Ireland, Wind of Italy, KPN of the Netherlands, and Telefonica of Spain. Others are making their own websites which are specifically for their mobile services such as Vodafone live! In France, there is a successful portal called Gallery which offers an access engine that will adapt the content of any site to most mobile terminals of all mobile operators, including MVNOs. Some argue that the difference between i-mode and WAP has substantially diminished since WAP 2.0.

Strictly speaking, direct and indirect data services are different in terms of their accessibility to web content. As indicated above, direct services like i-mode mainly provide specific web access to sites developed specifically for mobile terminals (wider access to the Internet is available but difficult to read using mobile terminals). Indirect data services usually using laptops provide unrestricted web access. However, when it comes to comparing data charges, these are based on volume of data and other factors (*i.e.* which content is accessible or not) has to be considered as a separate issue.

Figure 5. Connection patterns of data services



4.2.2. Distinction between private and corporate usages

Almost all operators differentiate between private and corporate usages for data services. Only Bell mobility of Canada, Orange of France (in 2005) and T-mobile of Hungary did not seem to have an explicit distinction. Even though operators have a distinction, some do not strictly differentiate private usage from corporate usage, and others apply the same prices to both categories. The former example is Lusacell of Mexico and the latter example is Swisscom of Switzerland.

Operators providing services only for corporate users are Telus Mobility of Canada, Vodafone of the Netherlands, Vodafone of Spain, Vodafone of Sweden, Orange Swiss of Switzerland, Sprint-Nextel and Cingular-AT&T of the United States.

The price difference between private and corporate usage varies country by country. As indicated above, Swisscom applies the same price, but TDC of Denmark, for example, sets the corporate price cheaper than the private price.

Especially for 3G services, operators tend to focus on corporate users at the beginning because prices are initially high and it is assumed that there will not be a rapid take-up in the initial period from private users.

4-2-3. Flat rate or non-flat rate (packaged plan or occasional usage plan in the case of non-flat rate)

1) Flat rate

For 3G data services 31% of all operators (16 out of 52 operators including corporate only usage) in 11 countries give subscribers the option of an unlimited flat rate.

Almost all operators provide both non-flat and flat rate tariff plans in parallel, but T-mobile and Eurotel of the Czech Republic and Verizon of the United States only provide a flat rate plan.

There are some variations in offering flat rate services. For example, in Korea, KTF offers a flat rate tariff per day as well as per month. TeliaSonera of Sweden offers a 'free' data tariff and in this regard it provides a flat rate, but they charge connection fees, which in fact can be regarded as data tariffs. Limited flat rate packages were not taken into account for this paper but some may be of interest to private users with limited data requirements *e.g.* Vodafone Italy provides '30 hours of data services for 30 euros per month'.

2) Non flat rate (packaged plan or occasional usage plan)

Almost all operators provide data services as a packaged plan, which includes some MB in advance and additional tariffs per MB. Additional tariffs per MB are not usually time limited although one operator, T-mobile of Hungary, has different tariffs for peak and off-peak times. Other operators, such as SFR of France, have minute-based charges. Only Vodafone of Germany offers both minute-based and quantity-based (additional tariffs per MB) tariff plans. There are also some cases in which operators (TeriaSonera of Sweden as indicated above or Vodafone of Ireland) charge connection fees for using data services.

In some countries the leading operators use different charging structures. This is the case in Denmark, Korea and Mexico, where one operator has adopted a flat rate tariff but the other operator has adopted a non-flat rate package. Presumably in these cases the market for mobile heavy data users is not large so that competition in this market segment has not developed.

4-3. International data roaming

Almost all 3G operators provide international data roaming services based on 3G technologies. However in general in 2005, European operators only covered European countries while North American operators tended to cover mainly North America. In addition, even international data roaming services based on non 3G technologies do not cover the same number of countries as voice services do. Therefore, there is room for improvement in this area.

4-4. Demand for data services

On the basis of existing indicators, Japan and Korea are the leading countries in the demand for 3G services with the largest number of 3G data subscriptions.

For example in Japan the proportion of data subscribers to total mobile subscriptions is around 90% (See Table 8.). Japanese customers have been accustomed to using data services with 2G and this has spilled over to 3G services where most subscribers are using data access. SMS services were not popular in Japan while non-subscription based data services in Europe or North-America, like prepaid customers using SMS services, were popular.

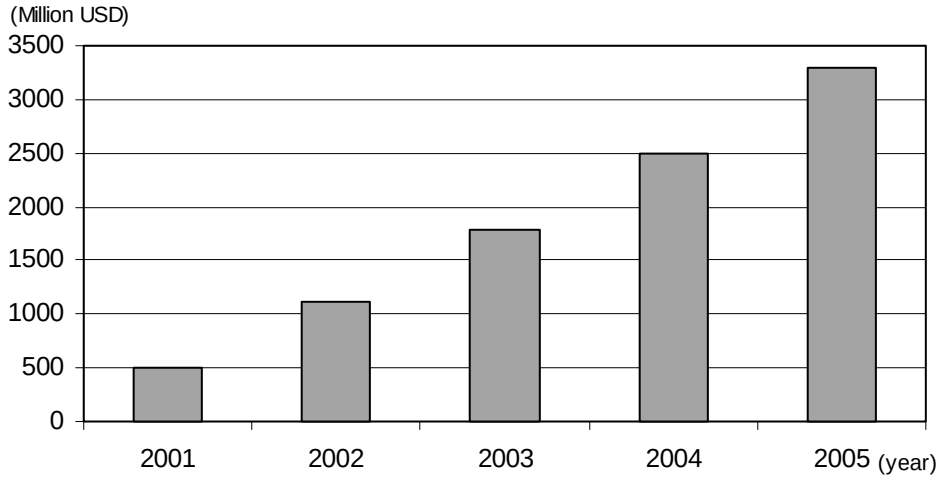
Table 8. The number of Japanese mobile data subscriptions (as of 31 January 2006)

Operators	Total mobile subscribers (A)	3G subscribers	Data subscribers (B)	Service	(B)/(A)
NTTDoCoMo	50,496,200	21,186,600	45,744,200	i-mode	91%
KDDI/au	21,791,900	20,850,300	19,934,400	EZ-Web	91%
Vodafone	15,134,300	2,541,000	12,835,700	Vodafone-live!	85%
Total	87,422,400	44,577,900	78,514,300	-	90%

Source: Wirelesswatch (http://www.wirelesswatch.jp/), OECD.
Note: Only 3G operators are listed.

In Korea the increase in subscriptions for mobile data services can be shown by the expansion of the wireless data market (See Figure 6.). Over these 5 years, this market has grown steadily.

Figure 6. Korean wireless data market



Source: SK telecom.
Note: The data include SK Telecom, KTF and LG Telecom.

In France, Orange France had over 1 million users on its 3G UMTS and EDGE mobile networks by the end of 2005. Orange's business comes from residential consumers who account for 80% of Orange's total 1.04 million broadband mobile users. However, the 20% of corporate customers have increased by sevenfold the amount of data they have sent over mobile networks since September 2004.[33] SFR also reports that it has acquired over 1 million mobile subscribers accessing its UMTS network, and to whom it provides its main products such as music downloads or video sessions. During the year 2005, 83 000 music tracks and 4.3 million video sessions were downloaded.[34]

In Portugal, Vodafone Portugal currently has over 330 000 3G customers and Vodafone's market share in 3G is estimated at 50% of the Portuguese market. The popularity of mobile broadband services and, in particular, the Vodafone Mobile Connect Card 3G, played an important role in increasing their market share.[35]

In the United States, Sprint-Nextel has reportedly seen 80% of its mobile handset customers sign up for its high-speed data service.[36]

Some analysts have indicated that the proportion of data subscribers to total mobile subscriptions in Korea was approximately 70% in 2004. In the United States or in European countries the rates of some operators were at most 30% but the average rate was around 20% in 2004.[37]

Generally speaking, in the United States or in European countries, the revenue source of non-voice services by 3G has mainly relied on SMS or sometimes on MMS,[38] whereas in Japan or in Korea they have depended on mobile data access or video services. There is an indication that low consumer interest in paying for mobile Internet (data) services and inferior user experience compared with fixed Internet or interactive TV alternatives will hamper the uptake of mobile data services.[39]

The cost of mobile data services is also a problem. There is an important price difference between data access using fixed broadband connections and data service using mobile networks (See Table 9.). In the case of music downloads, the mobile data price in France and in the United Kingdom is almost twice as much compared to using fixed broadband connections.

Table 9. Music offers by France Telecom groups (per track downloads)

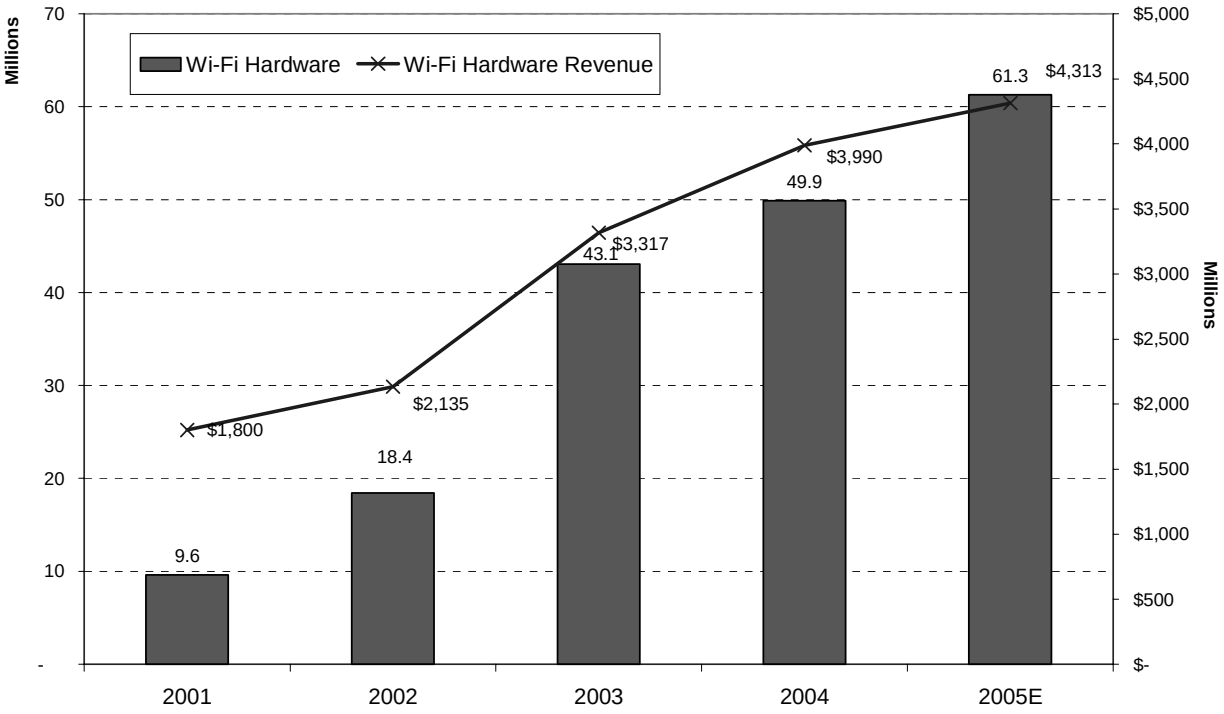
	Fixed Broadband	Mobile
France	Wanadoo France EUR 0.99 (USD 1.18)	Orange France EUR 2.00 (USD 2.38)
UK	Wanadoo UK GBP 0.79 (USD 1.39)	Orange UK GBP 1.50 (USD 2.63)

Source: Patricia Langrand, Executive Vice President, Content Division, France Telecom, 'Content strategy and update', 7 December 2005.

In addition, as this paper shows, even flat rate services are rather expensive except for some operators. However, for example, in European countries, ringtones, logos, gaming and music have currently driven usage across operators' data networks. This move could eventually stimulate demand for general data services by 3G networks from now on.

Using WiFi to deliver data to laptop computers, PDAs or other devices in a hotspot provides users with some mobility but not full mobility which is provided by high speed mobile networks. Nevertheless, such services can also be viewed as part of the process toward fixed-mobile convergence. The following figures also indicate the development of Wi-Fi in the world as well as the United States.

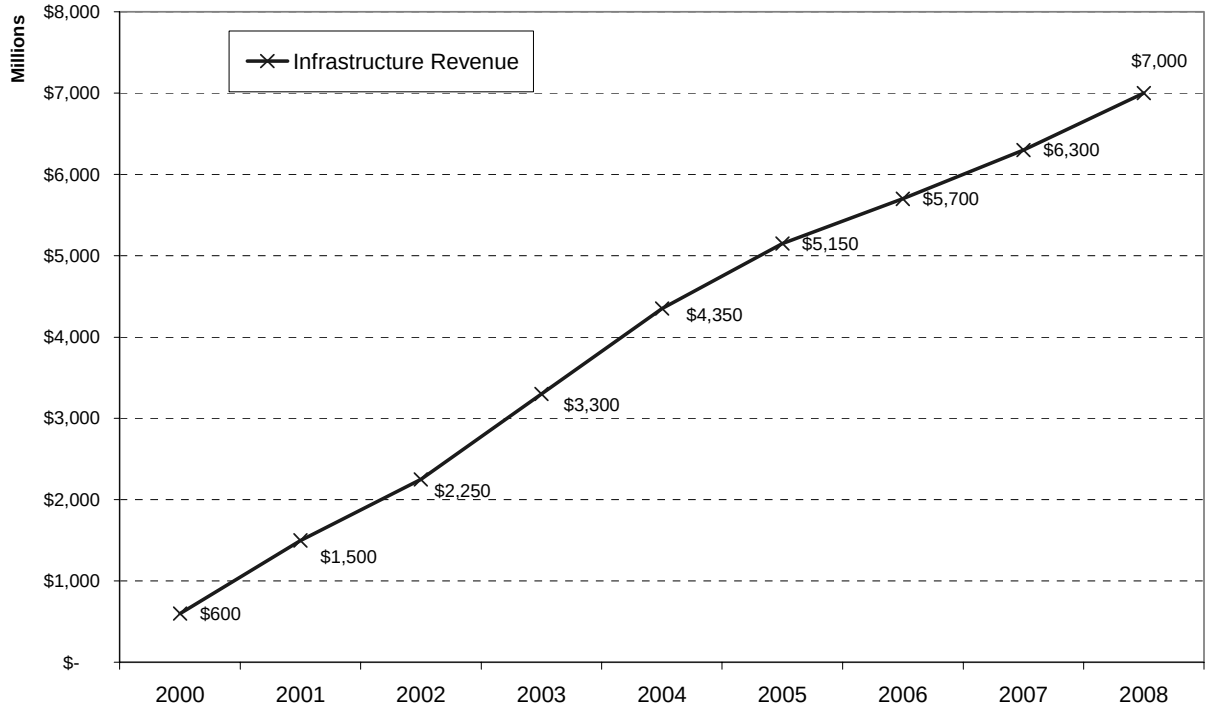
Figure 7. World-wide Wi-Fi Hardware Revenue and Unit Sales (2001-2005E)



Sources: In-Stat/MDR, October 2005, September

"Wi-Fi" collectively refers to the Institute of Electrical and Electronic Engineers' (IEEE) suite of wireless networking protocols 802.11b, 802.11g, and 802.11a.

Figure 8. Wi-Fi Hardware Infrastructure Revenue in the United States (2001-2008E)



Sources: TIA, Wilkofsky Gruen Associates 2005

"Wi-Fi" collectively refers to the Institute of Electrical and Electronic Engineers' (IEEE) suite of wireless networking protocols 802.11b, 802.11g, and 802.11a.

5. Mobile TV and radio

In parallel with the uptake of data services, operators are in the process of providing video services. These services are at present provided through 3G networks, but there are several experiments for new video services for mobiles utilising dedicated broadcasting networks such as DVB-H, T-DMB, ISDB-T, and MediaFLO. Also, this section addresses the direct competition to 3G services posed by services offered through advanced handheld terminal equipment and by satellite television and radio services.

This section will provide an overview of video services provided for 3G networks, and developments in terrestrial digital mobile TV (and radio) services, country by country.

5-1. Video services utilising 3G networks

New network technologies, such as WCDMA (and EDGE) allow the delivery of TV programming straight to mobile devices. These networks cover for example, 85% of the population in France and 70% in the United Kingdom.[40] However, there are only a few operators in the OECD who are conducting an extensive advertising campaign promoting their mobile TV services. That is because coverage of the 3G network is still not sufficient, the spectrum resource is very scarce and demand for the services is still in its infancy because of its pilot characteristics. In addition, the method of charging varies from operator to operator so that a comparison of the services of individual OECD operators is difficult. However, a number of operators with affiliates in other countries (*e.g.* Orange, Vodafone and T-Mobile) are offering the same services in these countries so that their prices can be compared (See Tables 10, 11, 12 as of March 2006.).

Table 10. Comparison of Orange mobile TV services (Orange World)

	Product name	Included capacity for transmission	Monthly tariff	Out of bundle costs	TV channels
Orange France	Orange World 10 €	25 MB, 25 hours access or 1 hour of Wi-Fi Unlimited TV services on week-end	EUR 10 (USD 11.90)	EUR 0.40 (USD 0.48) per MB, EUR 0.0067 (USD 0.0080) per minute or EUR 0.16667 (USD 0.19842) per minute for Wi-Fi	51
Orange Switzerland	Orange World	- (2)	CHF 16 (USD 12.21) (3)	-	29 (4)
Orange UK	Orange World Access 25 on pay monthly	25 MB	GBP 16 (USD 28.07)	GBP 0.70 (USD 1.23) per MB	16

Notes: 1) All services require an additional connection fee.
2) There are no limitations on usage.
3) 'CHF 1.50 per hour' or 'CHF 4 per day' tariffs are also available.
4) TV Channels of Orange Switzerland include German channels (11), French channels (8), Italian channels (6) and English channels (4).
5) As of October 2006, Orange France is offering 'option TV' (unlimited TV services), 'option totale TV' (unlimited TV and video services), and 'option TV musique surf' (unlimited TV and Internet browsing services).

Table 11. Comparison of Vodafone mobile TV services (Vodafone live!)

	Tariff	Out of bundle tariff	TV channels
Vodafone Germany	• EUR 10 (USD 12) per month • EUR 3 (USD 4) for 1 hour, EUR 5 (USD 6) for 2 hours	• EUR 0.75 (USD 0.89) per 5 minutes	30
Vodafone Portugal	• EUR 7.5 (USD 8.9) per month • EUR 1.5 (USD 1.8) for 24 hours	-	14 (3)
Vodafone Spain	• EUR 0.58 (USD 0.69) per minute	-	8
Vodafone Sweden	• SEK 69 (USD 9) per month	-	10

Notes: 1) All services require an additional connection fee.
2) Vodafone operators chosen are those that have added new TV channels since December 2005.
3) Additional payment required for 2 premium channels.

Table 12. Comparison of T-Mobile mobile TV services

	Tariff	TV channels
T-Mobile Germany	• EUR 7.5 (USD 8.9) per month • EUR 2.0 (USD 2.4) for 24 hours (2)	15
T-Mobile Austria	• EUR 7.5 (USD 8.9) per month • EUR 2.5 (USD 3.0) for 24 hours	9

Notes: 1) All services require an additional connection fee.
2) Only basic channels are available.

In the case of Orange, 25 MB transmission services have been used for comparison among Orange services or among Orange and other operators' services, even though Orange France offers 150 MB transmission (150 hours of connection or 6 hours of Wi-Fi). Only Orange France offers a Wi-Fi option.

Monthly subscription fees vary according to the operator. Monthly package prices provided by Vodafone and T-Mobile are based on a flat rate. However, Orange sets limitations on usage on the assumption that users view mobile TV for approximately 1 hour per day on week-days.

Orange provides significantly more TV channels than other operators. Most operators, other than Orange, Vodafone or T-Mobile, provide video clips or 'mobisodes' (short mobile episodes) rather than TV. Even Vodafone Portugal, for example, does not offer full-fledged live TV programmes. It offers both simultaneous (live) and recorded programmes. A national channel is broadcasted simultaneously between 7 a.m. and 9 p.m. from Monday to Friday and the slot between 9 p.m. and 7 a.m. the next day is filled with continuous recorded broadcasts of other programmes. On Saturdays and Sundays, there are simultaneous broadcasts between 7 a.m. and 2 p.m., and between 8 and 9 p.m., with continuous recorded news bulletins at other times.[41]

In the United States, operators are also providing video clips or video clip highlights over their third generation networks. For example, Verizon Wireless offers 300 channels of packaged video clips over their CDMA2000 1xEV-DO networks that run 30 seconds to 5 minutes and include sports, weather, news and concert videos. Sprint Nextel and Cingular Wireless are also offering services relying on MobiTV, a company that provides retransmissions of real-time cable television programming using streaming video, that has acquired more than 1 million subscribers worldwide.[42] Only Sprint Nextel is providing Sprint TV Live, which is similar to terrestrial broadcasting programmes.[43] Approximately 40% of Sprint Nextel customers sign up for 20 television channels.[44]

5-2. Video (and radio) services utilising broadcasting networks

This section will provide an overview of mobile TV services, which are under trial or consideration, except those utilising 3G networks. Information about new technology such as TDtv, which also has broadcasting characteristics, is also taken into consideration.

Australia

Bridge Networks, a subsidiary of Macquarie Bank's TV towers business Broadcast Australia, started its year long trial in Sydney at the end of July 2005 utilising DVB-H. Telstra will handle customer relations and at the same time provide some content.[45]

TDtv operates on the universal unpaired 3G spectrum bands that are normally available across Europe and Asia at 1900MHz and 2010MHz. Australia licensed this band separately and Personal Broadband Australia, rather than the cellular operators, holds this spectrum for doing business using iBurst[46] in all the main metropolitan areas. As a result 3G operators cannot provide TDtv based services at present.[47]

Czech Republic

T-Mobile Czech Republic was expected to launch a wireless broadband network in Prague by 2005, with nationwide coverage to be built during subsequent months, which was to be based on UMTS TDD (TDtv) technology from IPWireless. The aim was to maximize the value of its acquired UMTS licence by using this technology operating in its 'unpaired' 1.9 GHz UMTS spectrum. T-Mobile also plans to extend its wireless broadband network by summer 2006 to cover nearly half of the Czech population by utilising the same technology in the 872 MHz spectrum that it has acquired.[48]

T-Mobile Czech Republic will also reportedly begin testing mobile television, based on DVB-H which is provided by Siemens Communications.[49]

Denmark

The public broadcaster, Denmark Radio, Nokia and Motorola formed a consortium to implement pilot tests using the DVB-H standard to deliver video and data to mobile phones. This test, which started in the autumn of 2005, was co-ordinated by the Technical University of Denmark. Nokia and Motorola supplied phones, telecom operator TDC, the telephone services and Denmark Radio, the broadcast services.[50]

Finland

Digita, Elisa, MTV, Nelonen, Nokia, Sonera and YLE (The Finnish Broadcasting Company) started a mobile TV pilot in Finland. The project tested mobile TV services and consumer experiences with 500 users in the Helsinki region. The pilot continued until 20 June 2005.[51] The result was that 41% of the pilot participants would be willing to purchase mobile TV services and half thought that a fixed monthly fee of EUR 10 (USD 12) was a reasonable price to pay.[52]

The Ministry of Transportation and Communication then announced that a mobile digital television licence would be awarded to one network operator, which would be responsible for the transmission network and management of mobile television in Finland. As a requirement of the licence, technology used in the network would have to be compliant with the DVB-H standard and would also have to allow for the distribution of digital radio content.[53]

In reaction to this public tender, Sonera Mobile Networks, a subsidiary of Teliasonera Finland, Elisa Corporation, Digita Oy, and Telemast Nordic Oy filed a licence application to build a nationwide mobile television network in Finland. [54]

The Finnish government indicated that Digita Oy, a unit of France's TDF Group had won a 20-year-long licence to operate a mobile digital broadcasting network based on DVB-H in Finland; Finland would be the first country in Europe to open a commercial mobile phone television network; and Digita intended to start commercial operations in 2006.[55]

France

CSA (*Conseil Supérieur de l'Audiovisuel*) gave its approval for four trials of digital TV broadcasting to mobile receivers. Three of the trials are using DVB-H and the fourth is based on T-DMB. All of the trials are in Paris. The first trial on TDF started in September 2005 and lasted for nine months. The second trial also on the same channel 37 was directed by TPS with Orange France. Canal + also directed the third DVB-H trial on channel 29 for a period of nine months.[56] Alcatel, CNES and Orange France together are also testing satellite mobile TV using band S, in an experiment ending in December 2006.

The first results of the DVB-H trials in Paris conducted by Canal+, Nokia, Towercast and SFR revealed that of the 500 users, 73% had indicated their satisfaction and over 65% had indicated that they would be willing to subscribe to the services. The most popular programme services were news, music and sports.[57]

Regarding T-DMB, Samsung Electronics, Korean telecom systems and mobile handset provider, Bouygues Telecom, TF1, France's mobile TV operator, and VDL, France's digital network provider and equipment manufacturer, have all agreed to co-operate in the area of T-DMB to provide the six months' first trial service.[58] There is one transmitter transmitting 3kW on Band III block 11B. A technical test for

encoder, multiplexer, indoor/outdoor coverage and receiver test is being conducted. A consumers test will be carried out with 100 receivers.

Germany

Germany's Bundesliga Premier Soccer League games were broadcast to a limited group of users with smart phones using the DVB-H standard based on Windows media software. The test phase lasted until the end of the 2005 season. This pilot project involved Microsoft, operator DFL and Bundesliga.[59]

Telecommunications operators have made no commitments on DMB at present. For example, T-Mobile does not seem to have a plan to offer a DMB service and regards DVB-H as more appropriate.[60] However, LG Electronics announced that it would launch its DMB phone business in Europe with the first release of handsets in Germany in May 2006. In addition, DMB service is reportedly scheduled to go on trial in Germany during May 2006 and be commercialised in June,[61] in accordance with the 2006 FIFA World Cup calendar. For example, the company MFD (*Mobiles Fernsehen Deutschland*) plans a DMB service using a test licence for 3 years in the L-Band in 14 of Germany's 15 regions. Its commercial offer was launched on May 30 in 8 of the World Cup stadium cities. Content was live TV (ZDF) and video loops. A total of five programmes are planned. The four mobile network operators will offer the services as resellers. One of the two phones supporting the service is the LG V9000. Further roll-out is also planned. Firstly, the last four of the World Cup Stadium cities should follow 'as soon as possible', depending on network infrastructure delivery. The next roll-out is planned for North-Rhine Westphalen and cities with a population over 150 000 by the end of March 2007.[62]

Italy

Telecom Italia Mobile (TIM) and media group Mediaset announced an agreement to broadcast live television to mobile phones from 2006 using DVB-H technology. TIM will provide broadcasting programmes from Mediaset's three TV channels and football on its top-of-the-range mobile phones for five years from 2006.[63]

In addition, 3 Italia announced its plans to acquire the Italian national broadcasting station, Channel 7, which has a network licence for national digital TV with terrestrial frequencies. This agreement makes 3 Italia the first Italian mobile video provider able to offer DVB-H services on its own network. 3 Italia will implement the DVB-H network for its 4.8 million customers.[64] It is planning to launch a mobile television service called 'La Tre' in time for the FIFA World Cup. The service will initially provide 15 TV channels including services from Mediaset, Sky and World Cup coverage. Channels will increase to 20 by the end of the year, [65] at which time subscribers are expected to reach 500 000.[66]

Japan

The ISDB-T standard based service, which is called 'One-Seg', created in Japan, was launched in April 2006 for digital terrestrial television broadcasting to mobile handsets. Mobile communication carriers have already begun selling mobile handsets for this service. 'One-Seg' is a digital terrestrial TV service and can simultaneously receive data broadcasting. For example, it is possible to watch a programme that provides information on a restaurant and obtain information on the restaurant, such as its location, on the screen.

NTT DoCoMo and Nippon Television Network (NTV), the terrestrial TV operator, have agreed to a business tie-up to develop content and related services that will combine mobile communications and conventional TV programmes. In particular, these two companies will jointly study new business opportunities such as a service that will combine 'One-Seg' and i-mode services.[67]

In October 2004, Mobile Broadcasting Corporation started the first digital sound broadcasting service for mobile communications via satellite in Japan.

KDDI announced its support for MediaFLO technology and created a joint-venture planning company with QUALCOMM – MediFLO Japan Incorporated – with KDDI owning 80% of the company and QUALCOMM the remaining share holding. MediaFLO Japan Inc. is jointly working with the industry in Japan toward the introduction and the launch of a MediaFLO service delivering video and audio content to mobile devices. This joint venture is also expected to collaborate with content providers.[68]

IPMobile is planning to implement a trial of IPWireless's TDtv on its recently awarded 2010 MHz spectrum,[69] and its commercial service is expected to be launched in October 2006.[70]

Korea

Korean Broadcasters began transmitting commercial TV and audio services over a terrestrial DMB in December 2005. The Korean government, KBC (the Korean Broadcasting Committee) and MIC (the Ministry of Information and Communication), granted three licences to the incumbent terrestrial broadcasters (KBS, MBC and SBS) and three licences to newcomers (YTN, KDMB and U1media). They provide 7 TV and 13 audio programmes in Seoul Metropolitan area and its vicinity by using TV channels 8 and 12. The current model has free to air TV services and is expected to use advertising to generate revenue. However, data services will be charged and are expected to generate significant revenue. Many receiver manufacturers like Samsung, LG and Curitel began to roll out various types of T-DMB receivers, embedded in mobile handset, car navigators, laptops, PMPs (Portal Multimedia Players), digital cameras and USB memories. From May 2006, SKT, the leading telecommunication operator, started to provide T-DMB receivers, so all mobile telecommunication operators (KTF, LGT) in Korea are participating in T-DMB business. To improve the quality of the service, the T-DMB multiplexers have built underground repeater networks for 9 metro lines in the area. Furthermore they are preparing to provide TTI (Traffic and Travel Information) and interactive data services from the beginning of 2007. In the first half of 2006, more than 1.13 million T-DMB receivers were sold in the domestic market, and this is expected to accelerate as coverage expands to cover the nation by 2007.

On the other hand, S-DMB, DMB via satellite transmission system, which is also provided in Japan, started in May 2005 as a paying service. The number of subscribers as of June 2006 was 680 000.

In the case of DVB-H, the MIC (The Ministry of Information and Communication), the KBC (The Korean Broadcasting Committee), KBS (The Korean Broadcasting System), and the United Broadcasting Union decided to be involved in a pilot project. A task force was formed in 2005 to develop the DVB-H test trial which is planned to take place during the second half of 2006.[71]

Mexico

Mexico signed a Korea-Mexico DMB agreement witnessed by the Presidents of both countries in September 2005. The agreement is expected to promote field tests, joint projects and their monitoring. This DMB agreement, the second of its kind after the agreement with the state of Bavaria in Germany, will open the global market for the DMB service.[72]

Netherlands

KPN started its first field trial based on DVB-H of interactive digital television to a mobile device in July 2005. KPN implemented the trial in the Hague together with its partners Nozema Services and Digitenne, supported by TNO (the Netherlands Institute of Applied Geoscience). During the trials, KPN actively tested the interactive possibilities with digital TV on a mobile device.[73]

Spain

The Spanish network operator Abertis Telecom, broadcaster Radio Televisión Valenciana (RTVV), Nokia and Vodafone announced a trial using DVB-H enabled phones which aimed to evaluate their technological and commercial potential. The trial is due to be completed by April 2006 and complements others taking place in Barcelona and Madrid.[74]

Abertis also announced plans to launch nationwide DVB-H services in early 2007. In addition, Abertis, together with Telefonica and Nokia, presented the first results of their DVB-H trial. Five hundred users in Madrid and Barcelona participated in the commercial DVB-H trial. Results showed that 55% of participants were willing to pay for a mobile television service.[75]

Sweden

In the first half of 2006, Teracom, the national network carrier and an exclusive owner of the terrestrial radio and TV infrastructure in Sweden, started a pilot test based on DVB-H technology.[76]

Switzerland

Swisscom Broadcast and Swisscom Mobile implemented a technical trial in Bern based on DVB-H technology with around 100 participants. It ran from October to December 2005. Swisscom Broadcast's technology partner for the trial is the Finnish mobile phone manufacturer Nokia.[77]

United Kingdom

The trial for DVB-H services in Oxford, planned for a six-month period, was implemented in October 2005 by O2, which partnered with Arqiva and Nokia, for a trial with 400 participants.[78] The results of the trial indicated that 83% were satisfied with the service, while 76% would take up the service within 12 months.[79]

T-DMB trials commenced in London in June 2006, looking specifically at comparing the technological aspects of the different applications of the T-DMB and the enhanced packet IP based variant implemented in the United Kingdom by BT Movio. The trial will have a closed engineering user group. L-Band spectrum, which is available nationwide, is being used. Samsung Electronics and LG Electronics provide GSM mobile phone type receivers for this trial. Trial participants include BT Movio, Arqiva, Virgin Mobile, Samsung, LG, Perstel, OTT, and Pixtree.

Orange in the United Kingdom is also planning to test the IPWireless' TV standard, TDtv, which uses an existing but unused 3G spectrum to broadcast up to 50 TV channels for mobile phones.[80]

In addition, BT originally wanted to wholesale a mobile broadcast entertainment service to Virgin Mobile customers, and they spent 6 months testing it with 1 000 users in the London area utilising digital audio broadcasting (DAB) - IP technology. This service is expected to launch in summer 2006.[81]

BSkyB, a NewsCorp entity – international leader in the Pay-TV industry – announced in May 2006 the running of a technical MediaFLO trial in Cambridge to demonstrate the potential economic advantages of MediaFLO over alternative technologies.[82]

United States

Modeo (Crown Castle Mobile Media) tested its DVB-H mobile broadcasting network in the Pittsburgh area in 2005. It plans to launch the service commercially during 2006 in major US markets,

including New York City. It is also currently working on the nationwide deployment of its network to the top 30 US markets, with launches targeted throughout 2007.[83] Nokia, Intel, Motorola and other wireless equipment producers formed an alliance with Modeo to develop and spread the use of DVB-H.[84]

In late 2005, Verizon Wireless, which operates 3G networks based on CDMA technology, is expected to launch MediaFLO-based mobile TV services nationally in early 2007.[85] Verizon Wireless will provide the service offered and operated by MediaFLO USA Incorporated across the United States. MediaFLO USA Inc. will use a national spectrum licence in the lower 700 MHz (a single 6 MHz channel – 716-722 MHz) granted by the FCC after an auction process in 2003. The MediaFLO USA Inc. operated network is planned to support multiple 3G wireless operators in the United States.

Sprint Nextel is also involved in IPWireless's TDtv. It reportedly increased its investment in TDtv in addition to its previous investment of July 2005, and it is likely that it will also test the technology. It has a large portion of 2.5 GHz spectrum which is appropriate for TDtv.[86]

The most popular mobile audiovisual service in the United States currently is satellite radio, with 10.5 million subscribers as of April 2006. Subscribers may purchase terminals that are either free standing or can be installed in an automobile. The two satellite radio operators Sirius and XM Radio offer a variety of channels that include a mix of originally produced content and programmes purchased from independent producers. In January 2005, On2 Networks announced that XM Satellite Radio will use On2 Networks' VP6.2 codec for streaming video to mobile receivers in vehicles.[87] The popularity of media content players and other flash players may also eventually provide some competition to advanced 3G services in the United States. These terminals are highly portable, content is easily downloaded to them, and pricing packages are increasingly attractive. They rely on the relative ubiquity of fixed broadband Internet networks as compared to mobile broadband Internet networks.

Table 13. US Satellite Radio Subscribers 2002-2005

Quarter	XM Satellite Radio	Sirius	Total
04Y2002	347,159	29,947	377,106
04Y2003	1,360,000	261,061	1,621,061
01Y2004	1,680,000	351,663	2,031,663
04Y2004	3,200,000	1,100,000	4,300,000
04Y2005	6,000,000	3,300,000	9,300,000
01Y2006	6,500,000	4,000,000	10,500,000

Terrestrial radio operators in the United States such as CBS or Clear Channel Communications will reportedly transmit their sports contents to Sprint mobile subscribers. This is due to the fact that the people are spending more time with media content players and mobile phones and radio companies are working hard to make sure they are on those platforms, too.[88]

6. Fixed-mobile convergence

The term fixed implies traditional fixed non-wireless networks utilised by traditional PSTN, broadband, cable or other operators. There have been several developments in fixed-mobile convergence service provision. With convergence taking place at the network level fixed-mobile convergence is becoming a reality: e-mail boxes between fixed and mobile services are becoming unified so that there is now call forwarding to a single mail box; service is also becoming more unified with the development of handsets which allow users to make calls with special handsets at home on a fixed line and when outside on a mobile network.

Fixed-mobile convergence service will provide fixed network operators with an opportunity not only to generate new revenue streams and act as a one-stop-shop for customers' fixed and mobile needs, but also to defend effectively against mobile substitution. For mobile operators, the fixed-mobile convergence will give an opportunity to convince fixed-line users to cut the cord.[89] Nowadays, many operators have started to define a plan for fixed-mobile convergence based on NGN architecture.

In Korea, KT started its fixed-mobile convergence service called DU: in 2004 with KTF, KT's mobile services subsidiary. Special handsets will connect to KT's fixed network via Bluetooth indoors and to KTF's mobile network outdoors.

In the United Kingdom, BT's Fusion project, which started in June 2005, uses special handsets to connect to BT's fixed network via Bluetooth in the home or the office, to Wireless LAN at hot-spots and to Vodafone's mobile network in other places.[90] Vodafone's network is provided by way of a MVNO.[91]

Table 14. Tariffs of BT's Fusion

		Monthly tariff	Local fixed call (daytime)	Local fixed call (evening & weekend)
BT Fusion 100 (100 minutes calling time)	Landline plan	GBP 20 (USD 35)	GBP 0.03 (USD 0.05)/minute	GBP 0.055 (USD 0.096)/hour
	Evening & Weekend plan	GBP 23 (USD 40)	do.	Free
BT Fusion 200 (200 minutes calling time)	Landline plan	GBP 27 (USD 47)	do.	GBP 0.055 (USD 0.096)/hour
	Evening & Weekend plan	GBP 30 (USD 53)	do.	Free
BT Fusion 400 (400 minutes calling time)	Landline plan	GBP 42 (USD 74)	do.	GBP 0.055 (USD 0.096)/hour
	Evening & Weekend plan	GBP 45 (USD 79)	do.	Free

Notes: Monthly tariffs vary based on contract duration. The cheapest monthly tariffs have been chosen.

In the United States, Verizon started its service called iobi which enables it to forward calls between fixed and mobile networks by connecting multiple devices such as the PC and the phone.[92] AT&T (SBC) started the same kind of service called Unified Communications which allows subscribers to retrieve all their e-mail, voice mail, and faxes through PC, landline telephone, or wireless phone.[93] Those services have been provided from around 2003 to 2004.

In addition, in November 2005, Sprint Nextel announced a joint venture with Comcast, Cox, and Time Warner, in which the companies plan to offer a bundle of voice, data, and video services that will work seamlessly on their wireless and cable networks. Furthermore, some mobile operators in the United States are developing devices that maintain seamless Internet connectivity when moving from a wide-area 3G data network to an in-building Wi-Fi network.

Table 15. Tariffs of AT&T (SBC) Unified Communications

	Monthly tariff
Unified communications Fax Plus (1)	USD 21.60
Unified communications (2)	USD 19.43
Unified communications Lite (3)	USD 16.18

Notes: 1) This service manages landline voicemail, Cingular Wireless voicemail, e-mails and faxes in one central location with a separate number for inbound faxes.
2) This service manages landline voicemail, Cingular Wireless voicemail, e-mails and faxes in one central location.
3) This service manages landline voicemail, e-mails and faxes in one central location.
4) All services do not include call forwarding services.

In Germany, O2 Germany started to provide a fixed-mobile convergence service called Genion, which is provided only by the mobile operator. It offers a virtual fixed line area called home-zone through its mobile network and in this regard, the mobile network substitutes for a fixed network.[94] Thanks to this product, O2 Germany acquired approximately 11 % of the market share at the end of 2004.[95] Vodafone Germany followed O2 Germany and started to offer a similar service called Vodafone Zuhause. With this service, there is no difference in price between a fixed and a mobile network area. In addition, a flat rate plan is offered.

Table 16. Tariffs of O2 Germany Genion and Vodafone Zuhause

	Monthly tariff	Local fixed call
O2 Germany Genion	EUR 9.99 (USD 11.89)	[Within home-zone] EUR 0.03 (USD 0.04)/minute [Outside of home-zone] EUR 0.49 (USD 0.58)/minute
Vodafone Zuhause	EUR 5 (USD 5.95)	EUR 0.04 (USD 0.05)/minute
	EUR 20 (USD 23.81)	Free

There are a number of developments in the OECD area which are moving toward greater fixed-mobile convergence services. For example, Cesky Telecom announced plans to merge its fixed operations with its mobile subsidiary, Eurotel, and to change its name to Telefonica O2 Czech Republic.[96] In Ireland, Eircom announced that it would acquire Meteor, the country's third largest mobile operator.[97] In the United Kingdom, Orange plans to enter the fixed-line telephone market, the first move of its kind from a UK mobile phone group.[98] This service will run over the network of Cable & Wireless. In the United States, AT&T (SBC) will acquire the third largest US telecom group, BellSouth and as a result AT&T will have full control of Cingular Wireless which was a 60:40 joint venture between AT&T and BellSouth, even though this is not an acquisition between wired and wireless operators.[99] In Japan, NTT, the Japanese incumbent, stated that fixed-mobile convergence service would be offered through the collaboration of a group of companies.[100] Orange's service, referred to as Unik, is expected to be deployed on a large scale in the autumn of 2006.[101]

7. Regulatory and policy issues

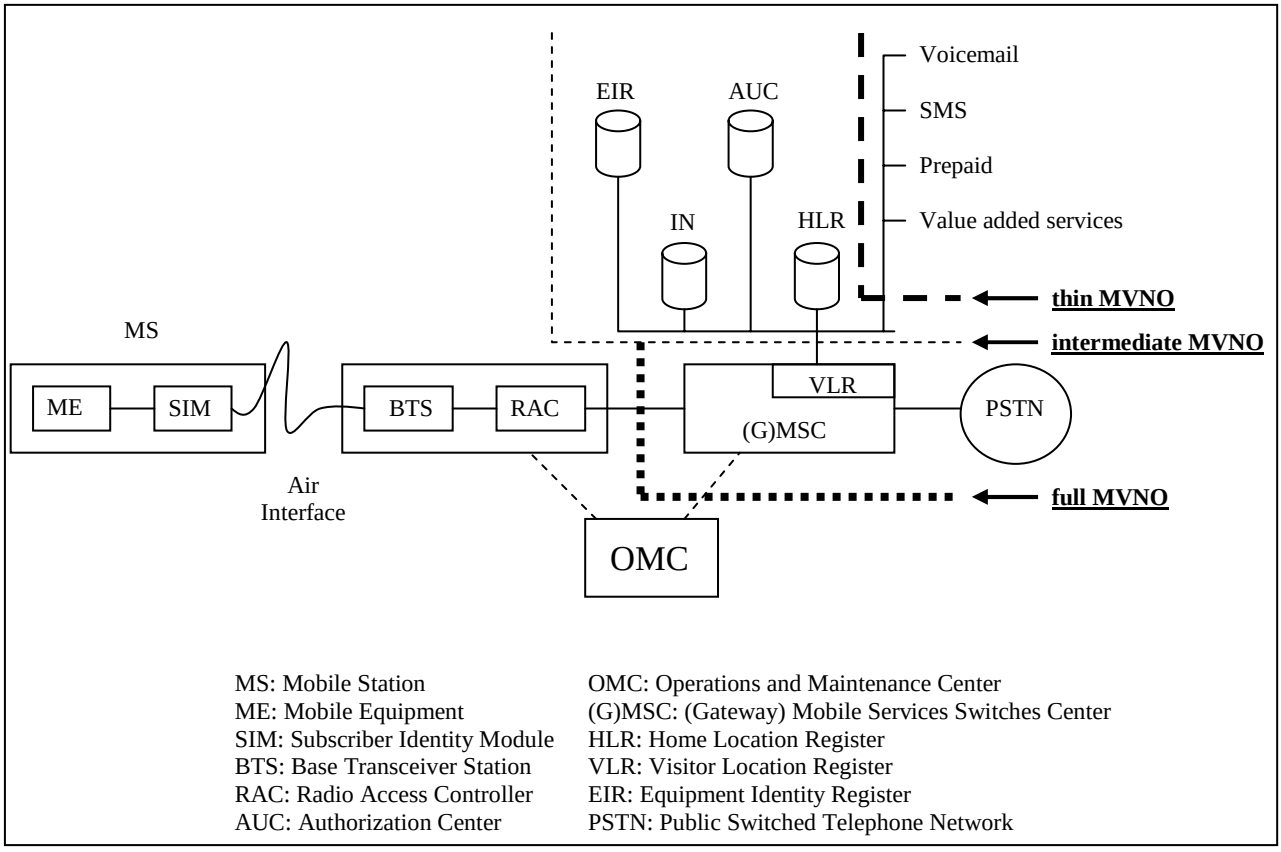
Regulatory and policy issues for mobile multiple play are similar to those in the fixed network world (see the paper 'Multiple Play: Pricing and Policy Trends' (DSTI/ICCP/TISP(2005)12/FINAL)), with the caveat that mobile operators typically face more direct competition from similar operators and, for that reason, may be less capable of exerting market power than incumbent fixed network operators and that mobile operations are regulated in order to control scarce spectrum resources.

7-1. MVNOs and data services

A Mobile Virtual Network Operator (MVNO) can be used by fixed network operators to provide mobile services and expand their multiple play offers. Three different MVNO models can be identified:[102]

- A 'full' MVNO involves the MVNO providing its own network core including a mobile switching centre, which may connect directly to the MNO's radio access controller.
- An 'intermediate' MVNO where the MVNO acquires a switched service, but provides its own home location register (HLR). Alternatively, the mobile network operator and the MVNO might jointly own the HLR and partition it.
- A 'thin' MVNO where the MVNO provides 'bolt-on' applications and content platforms. This MVNO model is not much different from an enhanced reseller.

Figure 9. Types of MVNOs



Source: 'Regulating Access to Networks', the Vodafone Policy Paper Series, Number 3, March 2005: 11.

MVNOs have developed relatively rapidly in Europe. In contrast, in Japan, there are not so many MVNOs. The MVNO business model in Japan is oriented to high value-added services which are based on technologies aimed mainly at corporate users who demand value added services. However, Japanese policy makers seem to be interested in MVNOs data services rather than voice services.[103] Softbank, eAccess, IPMobile, which acquired 3G mobile licenses in Japan in November 2005,[104] and Vodafone expressed their intentions to lease network capacity and, as a result, 20 to 30 entities are expected to enter mobile services from the summer 2006.[105] In the United States, a variety of specialised services based on

leased capacity have emerged in the market since there are no restrictions on how wireless operators may resell their capacity.

In the context of fixed-mobile convergence allowing market entry to MVNOs is important, although market development (current situation), investment climate, the situation of offering new services, price development, customer behaviour or impact of regulatory intervention should be taken into consideration. This might require putting in place specifc licensing requirements for MVNOs, as well as general regulatory provisions which might require mobile network operators to provide access to their networks. Some argue that in considering any possible mandated access provisions, care would need to be taken that the terms of access do not create a disincentive to invest in the facilities-based network. At the same time it might be important that MVNOs are subject to only light-handed regulation. MVNOs do not necessarily have to be full service providers as noted above. They could be specialised mobile data access providers aimed at providing data services to customers and generating price competition in this area. In addition, such data access services can be limited to data communications through net connection cards for laptops. In the longer term as other services develop, such as mobile TV, it may well be that MVNOs will also play an important role especially in the context of fixed-mobile convergence strategy by fixed PSTN operators.

7-2. Competition and numbering policy in terms of fixed-mobile convergence

Fixed-mobile convergence will play a critical role in the provision of mobile multiple play services and many operators are examining or starting to provide it. Network connection and integration between fixed and mobile operators could lead to concern that the connection will be closed within a company, and could easily lead to an anti-competitive situation. For this reason ensuring access by MVNOs can be important while, at the same time, ensuring that entities utilising MVNOs will not have a disadvantage. Again, however, some argue that access cannot be provided so inexpensively that the mobile network operators do not have a sufficient incentive to develop and maintain their systems. Note also that as an alternative to mandated access, general competition law may provide for sufficient protection against potential anti-competitive behaviour.

Furthermore, in terms of a multiple play with fixed-mobile convergence there is a possibility that a dominant operator will tie or bundle additional services while competitors have difficulty matching these bundles. In this regard, there are proposals that concerns over bundling should be met by requiring the filing of tariffs for service bundles (where individual services may be subject to economic regulation), and while not necessarily needing prior approval, the prices of these bundles should be subject to *ex post* challenge if there are grounds for believing that they are anti-competitive.[106] It is also important to keep in mind that bundles can have benefits for consumers, as well as raising potential concerns.

Numbering policies could also influence fair competition. Japan provides an interesting case. The government is examining setting a specific fixed-mobile convergence phone number which will not be a traditional geographic number but which will appear as a mobile number (likely to be ‘060’).[107] Normally, a geographic number enables a caller to estimate the cost of a call, but this type of non-geographic number will not, and thus if calls costs are determined on the basis of geographic location then the caller needs to be informed of the cost before undertaking a call session. In the case of BT’s Fusion, mobile numbers are maintained, but since both BT and Vodafone hold a location information management function which is normally owned by mobile operators,[108] adjustments will ensure that a call is terminated at a fixed network indoors and at a mobile network outdoors. O2 Germany’s Genion provides customers with an additional ‘fixed network number’, so terminated calls are distinguishable.

7-3. Walled gardens

Technological upgrades, such as through HSDPA, will enable users to access higher-bandwidth content such as moving images, music or Internet content which are similar to those on PCs. As indicated earlier, there is the possibility that mobile operators will have discretion to control bandwidth not only for indirect but also for direct data services. In the case of direct data services, users up to now have been satisfied with limited web access controlled by operators due to the bandwidth limitations inherent in the technologies, but with higher download speeds users will want to access the content of their choice. This may well lead to operators placing certain limitations on access and reserving bandwidth for the services they control. This has become evident with the development of VoIP services where a number of operators want to place limitations on Internet access to prevent users, especially those roaming, from accessing cheaper VoIP services aimed at by-passing high roaming charges. For example, Vodafone Germany is reportedly planning to disable Skype calls or other VoIP providers from July 2007.[109] T-Mobile, which provides unlimited mobile Internet services will also monitor usage to ensure that bandwidth is not being abused.[110] The French operator SFR reportedly announced in March 2005 that it intended to block both VoIP and peer-to-peer streaming traffic.[111]

Mobile operators are also concerned as a result of technological innovations which allow users to access TV services. For example, new devices such as the Slingbox[112] allow users to stream video from their home television over the Internet to another computer or to a mobile device with an Internet connection. Operators such as Verizon wireless, Cingular, Sprint or Nextel, all of which have started or are starting mobile TV services, seem to be concerned about how much bandwidth competitive services will occupy.[113]

The issue for the regulator is whether the operator possesses the market power to enable it to maintain unreasonably discriminatory access policies, and if so, how to provide reasonable access for users while ensuring that the integrity of the operator's network and quality of service is maintained. Network neutrality debates about wired networks have recently caught the interest of policy makers and the same debates will likely soon move to mobile networks as well. There is a difference between fixed and mobile networks in that mobile operators must rely on scarce spectrum resources through licensing requirements and may find it more difficult to expand capacity to meet demand growth. Some indicate that mobile operators generally face more direct competition from similar services and, for that reason, are typically less capable of exerting market power than incumbent fixed network operators. Policy makers may want to consider whether this difference requires that they should view network neutrality differently for mobile services. Policy makers also may want to consider whether mobile operators should be allowed to restrict Internet access in hotspots and place limits on the use of VoIP services in those hotspots.

7-4. Network coverage

In certain OECD countries the coverage of 3G networks is still not complete leading to call failures. In Europe, 55% of the population on average lives within the 3G service area. Italy and the United Kingdom are leading in network coverage whereas Belgium and Finland are lagging. For example, in Finland, 20% of the population lives within the 3G service area.[114] In Japan, it was reported that NTT DoCoMo had to continue selling 2G handsets because there were still some areas where calls sometimes failed and it wanted to keep its customers by providing 2G services.[115]

The growth in the demand for 3G data services will depend on adequate network coverage. In most 3G licences, especially in EU member countries, minimum coverage requirements are stipulated. Often these require that a specified percentage of population and/or geographic area is covered by a certain date. The target dates are between 2007 and 2009.

For mobile TV services, the choice between using 3G networks and/or a dedicated broadcasting network will, at the end of the day, depend on individual countries' capability for spectrum allocation or the operators' ability to establish networks reflecting user demand.

As the use of data services on mobile networks, and in particular 3G, grow, the more international roaming services will become important. In this context there will be a need to resolve the problem of high international roaming charges in those instances where market forces do not bring such charges down to reasonable levels. Ensuring that there are no restrictions imposed by mobile operators on the use by customers of Wi-Fi hotspots (for example to make VoIP calls) is one regulatory tool which might help in introducing competition in international roaming. The issue at the global level of inter-operability of different 3G standards for international voice or data services may also pose a challenge.

3G networks will compete with satellite, fixed broadband, and wireless local area networks in the provision of certain advanced, mobile and portable data, video, and audio services. Mobile audio and visual services offered over satellite networks are generally ubiquitous. These are popular in the United States, Canada and Korea. Advanced handheld terminal devices lend fixed broadband Internet networks an element of mobility. Given that fixed broadband Internet networks often may have higher speeds and greater ubiquity than mobile networks, they have some advantages over the 3G systems that offset their lack of mobility. However, for users who need mobility these devices are not competitive with 3G.

7-5. Mobile TV specific issues

7-5-1. Introduction of mobile TV through broadcasting networks

The model for providing mobile TV through broadcasting networks differs at present. Korea started T-DMB services in December 2005 and Japan started ISDB-T services (One-Seg) in April 2006 but the problem in both countries is that telecommunications operators are hesitating to commit themselves to these services completely. In the case of Korea there is also the need to clarify the regulatory situation in that mobile operators need to obtain licences to provide programming from the Korea Broadcasting Commission which is reluctant to provide these licences unless they are on the same terms and conditions as broadcasters. In addition, as the service is led by broadcasting operators and transmits terrestrial broadcasting programmes (which are normally received free of charge), mobile operators are hesitant to charge. There is also a concern that watching TV programmes will reduce the voice and data service consumption of customers. There is thus some reluctance by mobile operators to encourage the take up of these services by customers. On the other hand, they also contribute to the boom of, for example, T-DMB indirectly by distributing the mobile handset type receivers. Since May 2006, all mobile telecommunication operators in Korea have participated in T-DMB business by distributing T-DMB phone type receivers. They are also co-operating with T-DMB operators in developing new business models of interactive services and developing data services by renting a data channel from Multiplexers.

In Korea, the MIC has driven T-DMB promotion politically (See Box 2.).

Box 2. Korean case

The Korean Minister of Information and Communication reportedly expressed his intention to make the nation use a SIM (Subscriber Identity Module) card for all of the Korean mobile services (at present mobile phones in Korea, based on CDMA technology, do not use SIM cards). The Korean government wanted to diffuse mobile TV or Korea originated terrestrial DMB. By requiring the use of SIM cards the consumer will be able to change mobile handsets more easily by transferring SIM cards to a new terminal. Use of a SIM also provides manufacturers with more flexibility to market their new products since they can bypass the operators if necessary. However, this idea was only taken up for discussion and has not been elaborated further.

The Korean government wants to maintain terrestrial DMB as a free service because portable TV is an expansion of free over-the-air broadcasting for home viewers and it is using this platform based on very-high frequency (VHF) channels, which are regarded as a public asset.

Main source: 'Government Suspected of Trying to Tame Mobile Carriers', 12 December 2005, http://times.hankooki.com/lpage/tech/200512/kt2005121221064012350.htm.

7-5-2. Access to content

It is not clear whether content regulation is necessary or capable of being applied in a technologically neutral manner for mobile audiovisual services. At the same time it is probably premature to impose must-carry rules when the viability of business models is not yet clear. Nevertheless, it is important to monitor the market for possible competitive concerns.

As well, live streaming of raw material, or for mobile-only 'behind the scenes' content that complements traditional broadcasts, and entirely new, short-form programmes designed specifically for mobile transmission are coming into existence. These are backed by the emergence of 'amateurism' in content creation, to which the OECD Conference 'The Future Digital Economy: Digital content – creation, distribution and access' sometimes made reference.[116] For example, 3 Italia has a popular service called See Me TV. It allows subscribers to upload short video clips as viewer-generated content. The author of the clip receives a small payment each time the clip is viewed.[117]

However, once mobile TV services via broadcasting networks are introduced, some argue that mobile broadcast networks may become a bottleneck, that access to original content may become difficult, and that the content provided over these networks will be the same as that for terrestrial television. In turn, this may not stimulate take-up by subscribers except in the case of specific programmes (*e.g.* sport events, news). The fact that content may be tied up with specific distribution channels may also limit the access to content. For example, alliances such as between NTL and Virgin Mobile, or between BSkyB and Vodafone U.K., may mean that content controlled by those companies is not made available to others.

Policies in use in other areas may need to be applied to content for mobile services. An example would be policies such as the US FCC's programme access rules which prohibit unfair or discriminatory practices in the sale of satellite cable and satellite broadcast programming and prohibit or limit the types of exclusive programming contracts that may be entered into between cable operators and vertically-integrated programming vendors. The FCC's programme access rules are specifically directed at concerns over vertical integration between programmers and distributors and the impact on new entrants to the distribution market if they lack access to content. However, rules like the FCC's rules should only be considered if there is some evidence of vertical integration between mobile phone providers and content providers or that mobile video is in the same product market as fixed video such as cable service. In addition, it may be appropriate to consider whether antitrust policy on exclusive dealing is sufficient to alleviate possible concerns. These types of regulatory measures could be used to ensure that mobile operators can have access to content. In some countries, consideration is being given as to whether the nature of must carry could be balanced by similar 'must sell' or 'must broadcast' obligations on holders of terrestrial licences.

7-5-3. Must carry regulations

Mobile TV services utilising broadcasting networks available at present such as the Japanese One-Seg or the Korean T-DMB service transmit the same content as terrestrial TV programmes. In Japan, One-Seg service has the same classification as teletext, that is, it is considered as a subcategory of terrestrial broadcasting and there is an obligation to transmit the same content as terrestrial digital broadcasting. To this extent all terrestrial channels must be carried by One-Seg. In Korea, although terrestrial TV content is now dominant in T-DMB services the situation could change since many of the Korean T-DMB operators are newcomers who do not have terrestrial TV content and the incumbent terrestrial T-DMB broadcasters (KBS, MBC and SBS) are planning to increase gradually the portion of the content created specifically for T-DMB services.

Most OECD countries are taking steps to introduce terrestrial digital television which is expected to increase significantly the number of channels. If must carry applies to all digital channels for mobile television service providers, this might have negative implications for mobile multiple play providers depending on how mobile television services are accessed. Where there is a separate mobile TV broadcasting network then must carry may be more easily supported than where the existing mobile network is used to provide access to TV. As fixed-mobile convergence develops, it may be necessary to have different must carry requirements on fixed relative to mobile networks depending on the capacity of mobile networks to handle traffic. It is important that regulators tread lightly in this area in view of the fact that mobile TV services are new and innovative, and delay imposing broadcasting type obligations until it is clearly determined that they are necessary, although some minimum level of regulations may need to be considered even at an early stage. In this context the CRTC in Canada has stated that they do not intend to impose a requirement for mobile TV providers using the telecommunication network that content be sourced only from licensed Canadian programming services. It is also in this context that a report in France implied that must-carry requirements should be lifted for mobile TV using broadcasting networks (See Box 3.). In the United States, must carry regulations only apply to federally-licensed terrestrial stations, not to a ‘separate mobile TV network’. There are free speech and ‘taking of property’ issues that are implicated any time the United States government dictates carriage or content regulations. In the United States, the government has to demonstrate actual evidence of harm based on a comprehensive legislative record. The 3G content market appears to be viable and competitive and, as such, government regulations of this type are not warranted at this time. In addition, copyright issues are involved.

Box 3. The French report about 'digital TV and mobiles'

The report summed up regulatory issues for the introduction of mobile digital TV, even though it indicated that it should settle on a general plan based on experiments now on-going in France which are examining service types or business models.

- Regulatory scope

The authorization procedure in the sphere of terrestrial digital broadcasting focuses on 'editors' who create a service and the authorization is implemented on a service-by-service base, but in the case of mobile TV, 'distributors' should be selected. That is because they can stop a service in accordance with consumers' choice and start another flexibly. It is also inevitable that distributors will decide the qualities of the service based on bandwidth and the number of channels.

- Content regulations

Content regulations for existing broadcasting in reference to French culture or the arts should not be applied strictly to mobile TV services in order to maintain cultural diversity. Regulating new services could hamper the development of new services.

- Anti-concentration mechanism

Because of the scarcity of spectrum, and for the purpose of maintaining pluralism of expression, mobile TV services should include a mechanism to prevent concentration.

- Spectrum fees

Mobile TV services will compete with TV services through 3G (UMTS). Therefore broadcasters should be subject to similar spectrum fees.

Source: Daniel Boudet de Montplaisir (2005) *'Télévision Numérique Et Mobilité - Rapport Établi À La Demande Du Premier Ministre'* at: http://www.ddm.gouv.fr/IMG/pdf/boudet_tvmobile-5.pdf: 50-51, 54-56.

7-5-4. Geographic restrictions

Arguments have been made to extend the scope of the TV licence to cover mobile phone users (See Box 4.). For example, in the United Kingdom TV licensing authorities have indicated that the terrestrial license fee would apply to people watching any broadcasters' programmes (not just the BBC's) on mobile networks (the home license would cover the mobile set) and that this could affect even foreigners travelling into the U.K. who use laptops (or probably mobile handsets) to download streamed programmes from anywhere in the world.[118] This raises an issue of extra-territorial jurisdiction. Imposing payment as a licence fee in one country on content provided by another country could be controversial.

Box 4. TV licences for mobile TV

As mobile TV services, either via 3G telecommunications networks or via a broadcasting network, become commercial and expand in use, they may threaten the longer-term revenue stream from collecting licence fees.

In Germany, GEZ, the German TV and radio license fee collection authority, stated that in principle, all owners of TV-capable mobile phones would have a legal obligation to pay a TV licence fee. However, this obligation will only apply strictly to TV-capable mobile phones users who have not already registered a TV set with the authority. As 90% of German households already possess at least one TV set, and have registered this set with GEZ, the obligation to register their mobile phone and pay licence fees will be applied to only a small portion of mobile phone owners. In 2004, the prime ministers of the German federal states determined that as of 1January 2007, licence fees would also cover Internet-capable computers.[119]

In the United Kingdom, those who watch TV on mobile devices or computers need a TV licence. In reality, almost 98% of the country is already covered because most people possess a valid TV licence for home use. Those who watch live TV in the United Kingdom need a license and it does not matter where the program is being broadcast from. The rationale exists that standard licensing laws govern broadcasts on any device at the same time as they appear on TV. Viewers do not require a licence if they only use mobile phones or computers to watch shows which are not being broadcast live (such as video on demand).[120]

The arguments are almost the same in countries which have not adopted a TV licensing system. For example, in Japan, viewers of public broadcasting programs are asked to pay a receiving fee not for specific programs but to support the operation of NHK (Japan Broadcasting Corporation), the public broadcasting entity, as a whole. It is expected that viewers of the mobile TV called One-Seg will be covered under this receiving fee system in terms of public broadcasting. The CRTC in Canada has stated that mobile television services are, at present, exempt from regulation.[121]

7-5-5. Spectrum for mobile TV

Mobile TV services need higher frequencies which are sufficient to avoid noise interference and which suit the available antenna size in a handheld receiver and at the same time they need to be able to work reliably both inside buildings and on the move, favouring lower bands. The ideal frequencies are those already used for UHF TVs. For example, the DVB-H system prefers spectrum between 470 MHz and 650 MHz, which is prime spectrum real estate for any wireless radio service.[122] Although it may possibly have to wait until 2009 for service provision all over the United States, Qualcomm's MediaFLO already has control over UHF TV channel 55 (716-722 MHz) in the United States.[123] The US government auctioned 90 MHz of spectrum for advanced wireless services (AWS) in the summer of 2006. The spectrum will be used to increase voice, data and video usage across the United States. Many companies also may use existing spectrum leasing rules instead of federal leasing rules and other resale type arrangements to increase the likelihood of multiple play in the United States. A number of UHF bands will become available when countries switch over from analogue to digital transmissions. This would allow for mobile transmissions to enhance the range, picture quality and reception capabilities of mobile digital TV.

However, the preferred radio channels for DVB-H, for example, are not yet available throughout Europe although there are pilot projects underway at present in Finland, France, Spain, Italy and the Netherlands.[124] It will take until 2012 before analogue broadcast signals are switched off everywhere in Europe. On the other hand, most operators or allied manufacturers are expecting the launch of DVB-H services around 2006 or 2007 and at the latest 2008.

Ofcom, the United Kingdom regulator, for example, has stated that no one would have access to the UHF spectrum before 2008 since the United Kingdom digital switchover would start on a regional basis in 2008, and it is still too early to say if the preferred UHF spectrum from the digital dividend would be allocated for mobile TV.[125] In this regard, there is a discrepancy between regulators and operators or

manufacturers in that the formers tend to favour a technology neutral approach and that the launch of mobile TV services is closely related to a digital switch-over from analogue TV while the latter believe that an early launch (before 2008) of mobile TV services is feasible and necessary.

Regarding satellite digital audio radio services (SDARS) in the United States, the FCC adopted service rules for SDARS authorisations in the 2320-2345 MHz frequency band in March 1997, and it authorised two licensees, Sirius Satellite Radio and XM Radio to launch and operate satellites to provide SDARS in October 1997.[126]

APPENDIX

Exchange rates and PPP exchange rates (monthly average of February 2006)

	Exchange rates in national currency units per USD	PPP in national currency units per USD
Australia	1.35	1.42
Austria	0.84	0.90
Belgium	0.84	0.89
Canada	1.15	1.24
Czech Rep.	23.81	14.05
Denmark	6.25	8.63
Finland	0.84	1.03
France	0.84	0.91
Germany	0.84	0.92
Greece	0.84	0.75
Hungary	210.89	130.75
Iceland	64.19	105.91
Ireland	0.84	1.09
Italy	0.84	0.85
Japan	117.90	147.38
Korea	970.20	834.37
Luxembourg	0.84	0.90
Mexico	10.49	7.55
Netherlands	0.84	0.90
New Zealand	1.49	1.59
Norway	6.75	9.66
Poland	3.18	1.97
Portugal	0.84	0.68
Slovak Rep.	31.34	18.49
Spain	0.84	0.77
Sweden	7.83	9.16
Switzerland	1.31	1.81
Turkey	1.31940	0.963162
United Kingdom	0.57	0.62
United States	1.00	1.00

GLOSSARY

3G	Third-generation Mobile Network
3GPP	Third Generation Partnership Project
BRIC	Brazil, Russia, India, and China
CDMA	Code Division Multiple Access
DAB	Digital Audio Broadcasting
DMB	Digital Multimedia Broadcasting
DVB	Digital Video Broadcasting
DVB-C	Digital Video Broadcasting - Cable
DVB-H	Digital Video Broadcasting - Handhelds
DVB-S	Digital Video Broadcasting - Satellite
DVB-T	Digital Video Broadcasting - Terrestrial
EDGE	Enhanced Data Rates for GSM Evolution
ETSI	European Telecommunications Standards Institute
EV-DO	Evolution Data Only (Optimised)
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiple Access
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HSDPA	High-Speed Downlink Packet Access
HS-DSCH	High-speed Downlink Shared Channel
IMT-2000	International Mobile Telecommunications - 2000
IP	Internet Protocol
ISDB	Integrated Services Digital Broadcasting
ISDB-T	Integrated Services Digital Broadcasting - Terrestrial
ITU	International Telecommunication Union
LTE	Long Term Evolution
MB	Megabyte (1 024 kilobytes)
MBMS	Multimedia Broadcast Multicast Services
MIMO	Multiple-input Multiple-output
MMS	Multimedia Messaging Service
MVNO	Mobile Virtual Network Operator
NGN	Next-Generation Network
OFDM	Orthogonal Frequency-division Multiplexing
PPP	Purchasing Power Parity
PSTN	Public Swithed Telephone Network
QVGA	Quarter Video Graphics Array
RBOC	Regional Bell Operating Companies
SIM	Subscriber Identity Module
SMS	Short Message Service
TDD	Time Division Duplex

TDMA	Time Division Multiple Access
T-DMB	Terrestrial - Digital Multimedia Broadcasting
TD-SCDMA	Time Division - Synchronous Code Division Multiple Access
UHF	Ultra High Frequency
UMTS	Universal Mobile Telecommunications System
VHF	Very-High Frequency
VoIP	Voice over Internet Protocol
WAP	Wireless Application Protocol
W-CDMA	Wideband Code Division Multiple Access
WiMAX	Worldwide Interoperability for Microwave Access
Wireless LAN	Wireless Local Area Network

NOTES

[1] See DSTI/ICCP/TISP(2005)12/FINAL and *OECD Communications Outlook 2005*: 173.

[2] *OECD Communications Outlook 2005*: 108.

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[4] Frédéric Bourassa (2005) 'Rethinking Universal Service: Fixed to Mobile substitution', Working Party for TISP, December 5-6.

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[6] Verizon Wireless launched EV-DO technology in 181 markets in the United States, covering approximately 150 million people. It reports that its EV-DO delivers average user speeds of 400-700 kbps. Sprint initially deployed its EV-DO network to business districts and major airports in 34 US cities. By the end of 2005, it had deployed EV-DO in markets where approximately 50% of the US population lives or works. When Cingular acquired AT&T Wireless in October 2004, the latter had already deployed UMTS (or WCDMA) in six US cities: Seattle, San Francisco, Phoenix, Detroit, San Diego, and Dallas. Cingular commercially launched its service in 16 cities across the United States: Austin, Baltimore, Boston, Chicago, Dallas, Houston, Las Vegas, Phoenix, Portland, Salt Lake City, San Diego, San Francisco, San Jose, Seattle, Tacoma and Washington, DC. This included the replacement of the six WCDMA systems which had been previously deployed by AT&T Wireless. Cingular plans to continue deploying WCDMA with HSDPA throughout the majority of the largest US metropolitan markets in 2006. (From FCC's 11th report on competition in Commercial Mobile Radio Service)

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23 See at: http://www.3gtoday.com/wps/portal/!ut/p/kcxml/04_Sj9SPykssy0xPLMnMz0vM0Y_QjzKLN4q3dAHJmMUbxBub6keiijjCBbz1fT3yc1P1A_QLckMjyh0VFQHjnXaZ/delta/base64xml/L3dJdyEvUUd3QndNQSEvNElVRS82XzJfRkw!?page=home.

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ZDF (public channel) with 2 audio channels via T-DMB signals. In addition, Debitel has signed with a CAS (Conditional Access System) company for paying services.

Similar to the T-DMB trial project, MI FRIENDS (Mobile Interactive Favourite TV, Radio, Information, Entertainment, New Digital Service) started in Munich in June 2006. BLM (*Bayerische Landeszentrale für neue MedienHeinrich*) has initiated a MI FRIENDS project with Korean partners and got CELTIC (Cooperation for European sustained Leadership in Telecommunications) EURECA label on 20th of November 2005. Seventy five companies and institutes from nine countries are participating in the project. The project is composed of four sub-projects; Regensburg, South Tyrol, Lake of Constance and FIFA WorldCUP. FIFA WorldCUP 2006 project launched the first in Munich with 400 sets of L-Band/Band III dual band handset type receivers and 1 000 sets of USB receivers. The public broadcaster in Bayern, BR (*Bayerischer Rundfunk*) and the broadcasting R&D institute, IRT (*Institut für Rundfunktechnik GmbH*) broadcasted six videos and three audios on VHF 11D and 12A spectrum. Contents covered World CuP games and related information, entertainment, and travel information. The content was provided by ARD (Germany's 1st public broadcasting channel) and BR (public broadcaster of Bayern). Band III/ L-Band dual band GSM/UMTS phone of LG electronics was provided for this trial.

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