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**Working Party on Communication Infrastructures and Services Policy**

**FIXED-MOBILE CONVERGENCE: MARKET DEVELOPMENTS AND POLICY ISSUES**

## FOREWORD

This report was presented to the Working Party on Communication Infrastructures and Services Policy in December 2006 and was declassified by the Committee for Information, Computer and Communications Policy in March 2007.

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## MAIN POINTS

This paper provides an overview of the evolution towards fixed-mobile convergence (FMC). This evolution is driven by declining average revenues per user in both the mobile and fixed markets, and competition from other technologies, as well as from voice over Internet Protocol services. FMC will be facilitated by the adoption of Next Generation Networks in which all communications traffic uses Internet Protocol. The main findings are:

- There are ranges of ways being used to provide FMC services, some of which are more technologically integrated than others. Dual-mode cellular/Wi-Fi handsets and using Wi-Fi modems in the home environment to access VoIP through ADSL connections can be found in some countries. There are less evolved forms of FMC using cellular/Wi-Fi dual-mode handsets that do not have a handover function or have a handover function but do not utilise a fixed voice or broadband network in the home. Services also exist linking both fixed and mobile networks which are not technologically converged, such as those offering a single voice mailbox over both fixed and mobile networks.

- Voice and data services for cellular networks are being bundled, although data services are sometimes provided through wireless cards for laptops. In this case, there is no interface between cellular and Wi-Fi networks and those services tend to remain separate.

- Mobile based dual-mode services using home-zones are being provided by offering a virtual fixed line within a designated home-zone area. Prices in the home-zone tend to be in line with prices charged by fixed network operators and lower than cellular rates charged outside the home-zone.

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

- Since service contours and/or markets are changing, regulators may need to review existing market definitions and their regulations to ensure that existing frameworks are not a disincentive to the development of new services, and that existing frameworks treat new services in a technologically neutral way.

- Numbering policies may have to be reviewed to accommodate FMC services. If existing geographic numbers are used, then, in a calling party pays system, it may be necessary to devise ways to inform the call originator if different charges will be assessed based on the called party's location.

- In the context of the development of FMC services and allowing for inter-modal competition, it will be important to allow for portability of geographic numbers from fixed to mobile networks. Identifying the number easily does not require callers to contact directory services to find the new number of subscribers to FMC services.

- The development of FMC may also require that mobile operators participate in universal service obligations by paying into universal service funds but also benefiting from these funds as USO providers.

- The development of FMC services, which intend to decrease prices by using fixed networks in the home or setting a cheap home-zone through mobile services, might require regulators to forbear from imposing price regulations since they could distort competition, especially if price regulations are only imposed on incumbent fixed operators while new entrants are free from any regulation.

- Differences in regulatory treatment of interconnection and fixed-mobile termination rates could create distortions in a FMC service. Introducing a 'Bill and Keep Model,' where the call originator and the recipient of the call each pay their respective service providers for the portion of the network they are using, could eliminate the complexities or asymmetries between fixed and mobile networks, but this approach has not yet been widely used.

- It may be important for the development of FMC in some countries to require mobile operators to provide Mobile Virtual Network Operator (MVNO) access on reasonable terms, given that these mobile operators can quite easily provide fixed services to customers as part of their FMC services either through direct market entry or through access to unbundled loops. In considering possible mandated access provisions, however, care would need to be taken that the terms of access do not create a disincentive to the facilities-based mobile networks.

- It may also be important for regulators to develop adequate market tests given that the incumbents already have market power and often their mobile operators are also the market leaders; the development of FMC can augment this market power.

## 1. Introduction

This paper, following up on an earlier paper on 'Mobile Multiple Play: New Service Pricing and Policy Implications' (DSTI/ICCP/TISP(2006)1/FINAL), will examine recent changes in mobile communication, in terms of the evolution to fixed-mobile convergence (FMC). It begins by describing the technology, then analyses market developments in OECD countries, and finally explores policy implications.

FMC services, a detailed description of which will be presented in the following sections, represent a significant challenge to all telecommunication operators in the next few years. Bundling of disparate services over separate networks has become viewed as a marketing step necessary to support customers, and therefore fixed operators, for example, should bundle a cellular or FMC service as a total service package. From the viewpoint of services, the fixed network operators are threatened by the penetration of mobile services into their market, while the mobile operators are faced with the saturation of second generation mobile markets and the need to induce customers to shift to third generation markets. At the same time, in some countries, an increasing number of fixed network operators which traditionally did not provide mobile services are now entering into mobile markets through MVNOs (mobile virtual network operators). In addition, both mobile and fixed telecommunications operators now have to contend with IP-based services using fixed or Wi-Fi networks and have to make investment decisions regarding the development of Next Generation Networks (NGN) or base systems such as the IP Multimedia Subsystem (IMS).

FMC services are not recent. For example, TDC in Denmark started offering its 'Duet' services in 1997 where calls are routed to the user's mobile or fixed network depending on whether his or her mobile is switched on or off.[1] BT in the United Kingdom launched 'Onephone' in 1999 with a DECT (Digital Enhanced Cordless Telecommunications)/GSM phone.[2] DECT functioned indoors as a digital cordless telephone connected to a fixed network and outdoors as a mobile phone using GSM technology. These services were frontrunners in FMC yet both failed to attract many subscribers for completely different

reasons; indeed, although the former offered the advantages of a single number and a single bill, it relied on the use of two handsets (*i.e.* fixed and mobile handsets), and whereas the latter offered manual switch-off between networks, its unique handset was expensive and bulky, the user was presented with two separate bills[3], and calls often got disconnected when switching from one mode to another.[4]

BT decided to pursue its strategy of relying on a single mobile handset and, after making some improvements to its Onephone service, re-entered the FMC market in 2005 under the name of BT Fusion. In Korea, KT began offering a similar type of service to BT Fusion in 2004 (Onephone 'Du:'). Two US companies, Verizon and AT&T (SBC), developed strategies based on network technology rather than mobile handset technology. Around 2003-2004, Verizon started providing services enabling the transfer of calls between fixed and mobile networks through the connection of multiple devices such as PCs and phones whereas AT&T (SBC) allowed its subscribers to retrieve their e-mail, voice mail and faxes through PCs, fixed-line telephones or mobile phones.[5]

FMC services are at present provided by PSTN network operators; however, cable operators are also beginning to offer these services and are keen to provide multiple play services such as triple play or quadruple play. Cable operators thus are becoming direct competitors to PSTN operators. This direct competition likely will increase.

A variant of FMC called home-zone service is also not new. Here, mobile operators offer a virtual fixed line area called the home-zone through their mobile network. Sonofon in Denmark started its UnoFon service in 1997 which includes home-zone services.[6] Strictly speaking, this type of service is referred to as fixed-to-mobile substitution leading to an increase in the proportion of mobile call volumes with respect to all voice volumes. Although home-zone services are regarded in this paper as a fixed-mobile converged service, they are conceptually different from to FMC service.

There was a surge of interest in FMC in 2005 with the development of new technology. Network technology such as IMS (IP Multimedia Subsystem), which provides a standardised next generation architecture based on Internet Protocol (IP) for operators, allows for the provision of mobile and fixed services using converged handsets embedding a radio interface such as cellular/Wi-Fi or cellular/Bluetooth dual-mode handsets.[7] IMS was initially developed for mobile networks but has evolved to support fixed services as well allowing for FMC.[8]

Another factor promoting FMC is the trend towards VoIP-enabled wireless telephony (VoWi-Fi), *i.e.* devices that use Wi-Fi to connect to a VoIP service such as Skype rather than roam between cellular and wireless LAN systems.[9] Most of the VoWi-Fi operators are at present providing Wi-Fi based only services, but some are starting to offer FMC services by combining cellular services with VoWi-Fi. Challenges to mobile telecommunications operators are also coming from Wi-Fi hotspot operators, such as Boingo, allied with Skype, and are leading some mobile operators to also consider linking their cellular networks with Wi-Fi hotspots.[10]

Industry expectations are that FMC services will depend on Wi-Fi. Table 1 shows one measure of the availability of Wi-Fi hotspots. Estimates indicate significant growth in the number of hotpsots, for example, in the United Kingdom, the number of Wi-Fi hotspots almost doubled between June 2005 and June 2006 from 8 500 to 14 600.[11] In addition to Wi-Fi, new wireless technologies such as mobile WiMAX can influence the provision of FMC services.

**Table 1. Number of Wi-Fi hotspots (as of 11 September 2006)**

| Top 10 Countries | | Top 10 Cities | | Top 10 Location Types | |
|---|---|---|---|---|---|
| US | 41 007 | Seoul | 2 056 | Hotel / Resort | 31 887 |
| UK | 14 933 | London | 1 943 | Restaurant | 25 480 |
| Germany | 12 509 | Tokyo | 1 843 | Cafe | 15 802 |
| South Korea | 9 415 | Taipei | 1 786 | Store / Shopping Mall | 14 834 |
| Japan | 6 258 | Paris | 1 204 | Other | 7 850 |
| France | 5 334 | Berlin | 823 | Pub | 5 348 |
| Taiwan | 2 899 | San Francisco | 805 | Office Building | 2 386 |
| Italy | 2 549 | Daegu | 787 | Gas Station | 1 735 |
| Netherlands | 2 517 | Singapore | 671 | Airport | 1 580 |
| Australia | 2 180 | New York | 669 | Library | 1 400 |

*Source*: JiWire (http://www.jiwire.com/search-hotspot-locations.htm).

The high penetration of mobile phones in OECD countries has led to significant substitution with respect to the share for traffic between fixed and mobile networks. For example, in France, the volume of voice calls through fixed networks has decreased while voice calls through mobile networks have increased (see Figure 1).

**Figure 1. Call volumes of French fixed and mobile telephone networks**
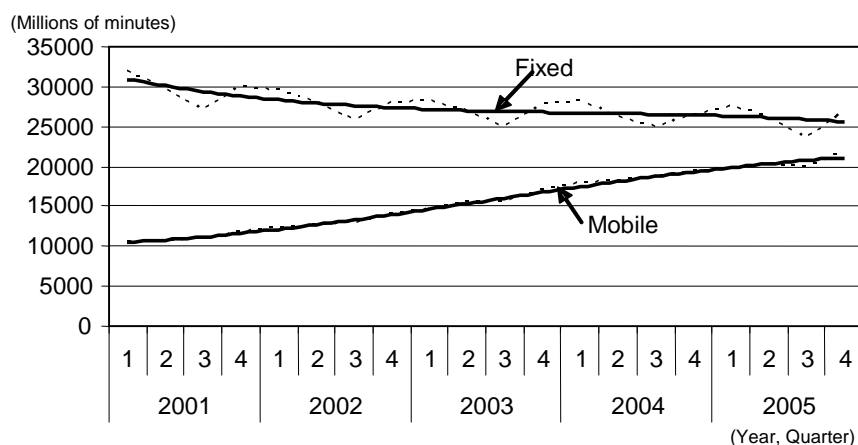


*Note*: Bold lines are trend lines (3rd order).

*Source*: ARCEP (*Le marché des services de télécommunications en France*).

In the United Kingdom substitution has also taken place (Figure 2) but to a lesser extent than in France, although there is also an impact of increased mobile penetration resulting in increased mobile usage. One survey indicates that the majority of those surveyed in the United Kingdom (65%) were not as keen to abandon their fixed line services as in other European countries surveyed.[12]

**Figure 2. Call volumes of the UK's fixed and mobile telephone networks**
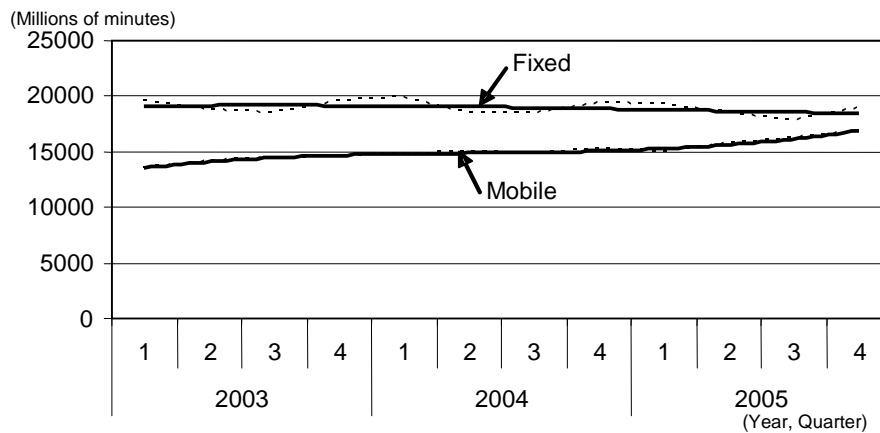


*Note*: Figures of fixed network were taken from residential 'UK geographic calls' and figures of mobile network were taken from 'UK calls'.   Bold lines are trend lines (3rd order).

*Source*: Ofcom ('The Communications Market 2004 - Telecommunications Appendices' (August 2004), 'The Communications market - Telecommunications Appendices' (January 2005), 'Telecommunications market Data Tables Q4 2005' (June 2006)).

With the introduction and adoption of FMC services, changes in these trends in individual countries should be watched. One of the variables influencing future trends could be the number of mobile-only households. Within the EU25 countries, the percentage of households that only use mobile phones is 18 %.[13]

Another variable to consider in the context of FMC is the proportion of mobile call volumes with respect to all voice volumes. This proportion is close to 70% in Finland, over 50% in Austria,[14] more than 40% in France and around 30% in the United Kingdom[15]; however, in Germany, it stands at only 12%.[16] This leaves room for German mobile operators to take market share from fixed network operators, especially through the provision of home-zone type services. Lastly, in reference to the process of transition to NGN or IMS, FMC does not concern voice calls only but covers a range of services including television and other multimedia services.

Some incumbent fixed operators that also provide cellular services are integrating their fixed and mobile operations in order to offer converged services and take advantage of the economies of scope and scale provided by next generation switching systems.

**2. Technological aspects**

This section will look at technologies and activities which have a relationship with FMC services. Mobile WiMAX, for example, is in itself an independent technology and is as yet not related to any FMC services; however, because it is in the process of being incorporated as a critical technological factor in FMC, this paper will make reference to it.

### 2-1. Unlicensed Mobile Access (UMA)

UMA technology can provide access to GSM and GPRS mobile services over unlicensed spectrum technologies. By deploying such UMA technology, service providers can enable subscribers to roam and handover between cellular networks and public and private unlicensed wireless networks using dual-mode mobile handsets.[17]

**Figure 3. How UMA Technology Works**



*Source*: http://www.umatechnology.org/overview/index.htm.
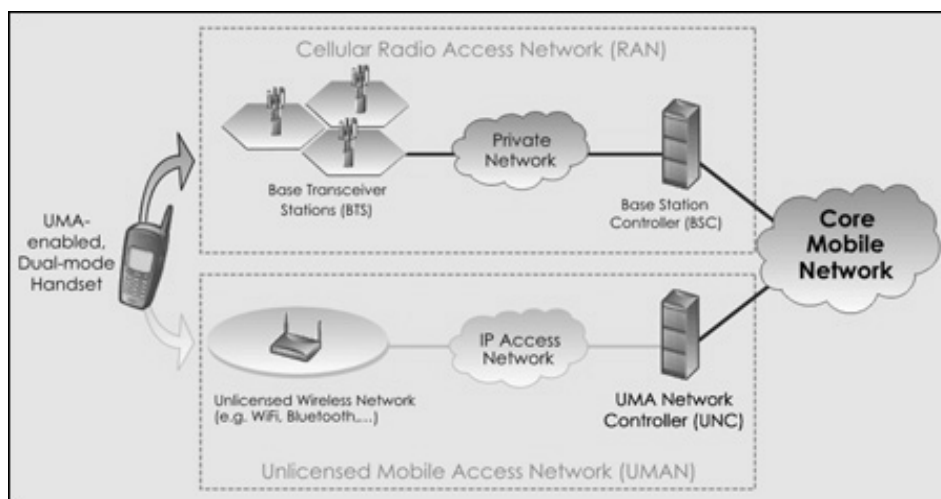
UMA's comparative advantage lies in its ability to provide FMC capabilities based on existing wireless networks, while Session Initiation Protocol (SIP), the protocol for IP transmission procedures standardised by IETF, provides complete converged services into the IP Multimedia Subsystem (IMS) as shown below.[18]

### 2-2. FMCA

The Fixed-Mobile Convergence Alliance (FMCA) is a global alliance of telecommunication operators. Their objective is to accelerate the development of FMC products and services. The FMCA was established in July 2004 by the following six founding members: BrazilTelecom, BT, KT, NTT Communications, Rogers Wireless and Swisscom. The group's membership has since increased to 26 operators from 24 different countries or regions (24 out of the 26 operators are integrated telecommunications operators owning both fixed and mobile networks, and 16 out of the 24 countries or regions involved are members of the OECD).[19]

The FMCA is not a standards development organisation but aims to accelerate the development and adoption of convergence technologies by producing common telecommunication operator requirements for converged cellular/Wi-Fi/WiMAX products and services in areas such as service capabilities, handsets, access points and gateways, networks and architecture, and roaming and converged applications.[20] The FMCA came as a result of telecommunications operators facing difficulties in communicating with several domestic and/or international vendors when deploying their businesses internationally.

For that reason, the FMCA released product requirement documents in terms of Bluetooth CTP, Wi-Fi UMA, and Wi-Fi SIP in 2005. It is also seeking to ally itself with a number of technical alliances (3GPP SA1, CT1, 3GPP2, ETSI-TISPAN, IEEE and Wi-Fi alliance).[21]

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**Box 1. Main functions of the FMCA**

- Timely delivery of the FMCA product requirement definitions and other technical materials as well as strategic engagement with standard-development organisations or forums and the wider vendor community

- Timely generation of common operator requirements for converged cellular/Wi-Fi/WiMAX products and services in areas such as service capabilities, handsets, access points and gateways, networks and architecture, roaming and converged applications

- Timely delivery of key FMCA work items to be incorporated into final product requirement documents or other technical materials

- Articulation of identified FMCA handset requirements to Tier 1 and 2 handset vendors

- Alignment between FMCA's and handset vendors' product roadmaps and visions. It also monitors convergence initiatives worldwide, the customer experience, market research and in-depth market analyses.

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*Source*: http://www.thefmca.com.

### 2-3. Femtocell

The wireless equipment industry provides indoor coverage through picocells, small cellular base stations, in high traffic and high value locations such as hotspots. However, traffic is usually insufficient in residential environments to recover costs, but companies such as picoChip, RadioFrame Networks, ip.access, or UbiquiSys[22] are now able to address residential indoor coverage through low-cost femtocells (defined as 'small cellular base stations designed for use in residential or corporate environments'.[23] ).

Where UMA-enabled cellular/Wi-Fi dual-mode handsets are utilised, Wi-Fi access points are obviously required. Providing this access with picocells could be very expensive. Femtocells, on the other hand, do not require subscribers to change their mobile handsets into dual-mode handsets, and UMA-enabled femtocells, which are at present applicable for 3G or 2.5G, can have air interface with existing handsets. This provides mobile network operators with an effective way to cope with competition from VoIP, UMA or VoWiFi services. Using a single handset improves customer loyalty and reduces churn.[24] In addition, the backhaul traffic from femtocell stations to a mobile core network will be through fixed broadband, and therefore fixed operators are supposed to be involved in this networking.

There is still room for improvement with regard to the introduction of femtocells in that while vendors have made significant progress in addressing cost and interference issues, less progress has been made in solving the problems of integration between femtocells and mobile core networks.[25] One study indicates that the arrival of femtocell access points may prove disruptive for the cellular/Wi-Fi dual-mode handset vendors.[26] In this regard, T-Mobile in the United States is reportedly testing femtocells as well as UMA to weigh the pros and cons of rolling out dual mode coverage.[27]

### 2-4. IP Multimedia Subsystem (IMS)

IMS was proposed by 3GPP (3rd Generation Partnership Project) and was originally meant to provide IP-based communications over mobile networks. At present, it uses a SIP protocol and is regarded as the leading standard for the NGN since it can also be used with fixed IP-based networks.[28] Because the initial cost of IMS solutions has remained high, some operators are still hesitating to commit to IMS. However, IMS-related standards are maturing and IMS systems with improved capabilities and performances are emerging, and the cost of introducing IMS is decreasing.[29]

One of the main reasons for introducing IMS is to provide a better method for charging multimedia sessions. Operators can charge multimedia sessions in a variety of ways; for example, they can apply a charge for the individual use of each available product, or they can apply a single rate for access to all services.[30] This can be done because, as shown in Figure 4, identity management (IM) is an integral part of the core IMS technology structure. Since IMS can be used by fixed incumbents, mobile operators, cable companies and other unbundled independent operators, it helps at the technological level to ensure a level playing field among operators and service providers[31]

**Figure 4. Diagram of IMS**
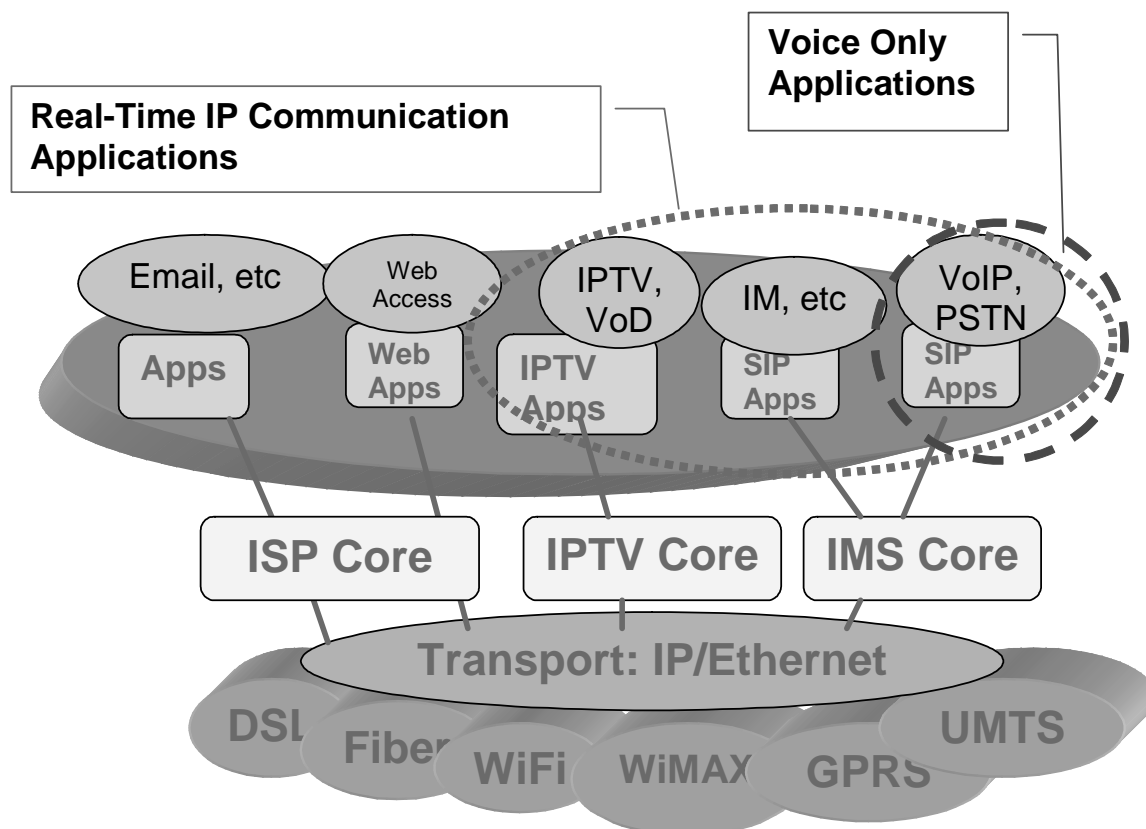


*Note*: IM means an identity management.

*Source*: Colin Pons (Kpn) 'IMS: Walled in or Open Does the Open IMS exist?' 18 May 2006: 6.

## 2-5. Mobile WiMAX (including WiBro)[32]

Mobile WiMAX was approved by the WiMAX Forum in February 2006. The WiMAX Forum is a non-profit association formed in June 2001 which seeks to facilitate the deployment of broadband wireless networks based on the IEEE 802.16 standard by ensuring the compatibility and interoperability of broadband wireless equipment.[33] Based on 802.16e-2005, a variant of 802.16, Mobile WiMAX is intended to enable WiMAX systems to address portable and mobile applications in addition to fixed applications.

One of the main characteristics of Mobile WiMAX is its introduction of OFDMA (Orthogonal Frequency Division Multiple Access). OFDMA divides a signal into sub-channels (*i.e.* groups of carriers), with each sub-channel being allocated to a different subscriber.[34] In addition, it ensures mobile broadband services at vehicular speeds faster than 120 km/hour.

The WiMAX Forum is working on a schedule to certify all Mobile WiMAX-based products starting in the fourth quarter of 2006. It implemented the certification and testing twice as of March 2007. The first commercial mobile application for WiMAX certified products took place in Korea with the launch of WiBro services. WiBro uses the licensed 2.3 GHz frequency band with an 8.75 MHz channel bandwidth. WiBro and Mobile WiMAX use OFDMA, but the number of sub-channels and the frame structure within a given sub-channel differs between the two standards.[35]

The two Korean WiBro operators, KT and SKT (SK Telecom), launched their offers at the end of June 2006, but the pace has been slow due to limited network coverage and competition from high-speed cellular services such as 1x EV-DO, W-CDMA and HSDPA. It is reported that KT had signed up only 479 WiBro customers by the end of August, and SKT had only 15.[36] There is also room for improvement in interoperability between WiBro and mobile WiMAX. Korean firms backing WiBro such as LG reportedly indicated that they would make mobile WiMax and WiBro fully interoperable, but it is not clear whether this has yet been achieved.[37]

EVDO and HSDPA/HSUPA (HSPA) are FDD (Frequency Division Duplex) implementations operating on a carrier frequency of 2.0 GHz whereas mobile WiMAX is a TDD (Time Division Duplex) implementation operating at 2.5 GHz.[38] In terms of throughput or spectral efficiency, mobile WiMAX is supposed to be twice as powerful as EVDO or HSPA.[39]

Other operators outside Korea are planning on entering the mobile WiMAX market. Irish Broadband, a wireless broadband provider based in Ireland, is planning on providing this service by early 2007[40], and eircom in Ireland also announced its intention to use WiMAX to provide broadband in areas where DSL is not currently available.[41] In the United States, Sprint Nextel and Clearwire announced plans to deploy networks based on the Mobile WiMAX standard. In addition, MobiTV (a mobile television and music service provider) is considering the delivery of mobile television and other multimedia content with mobile WiMAX.[42]

### 2-6. IEEE 802.20

Qualcomm is the main promoter of this technology. IEEE 802.20 is based on 3G technology while mobile WiMAX is an extension of WiMAX which was intended for a fixed usage. IEEE 802.20 also uses OFDMA for its efficient use of bandwidth, but it switches to CDMA when appropriate. In this regard, it was thought from the beginning that both IEEE 802.20 and 3G would be operated in a dual mode. IEEE 802.20 based commercial services are supposed to reach the market in 2008.[43]

However, standard development for IEEE 802.20 reached a deadlock in October 2006 because the chair of the IEEE Standards Association (IEEE-SA) judged that IEEE 802.20 had not kept to the principles of openness or balance.[44] The reorganisation of the 802.20 standard to facilitate the development of a mobile broadband wireless access standard is also being examined.

### 3. Market description (The analyses presented in this section are based on information available as of September-October 2006.)

### 3-1. The rationale for FMC

The voice market has changed significantly with the rapid diffusion of mobile telephones. People expect to call and be called wherever they are and increasingly, as noted above, are using their mobile phone as their sole means of communication. At the same time, new features are being added to mobile phones allowing them to be used for Internet access, to provide location information, and to be used to access multimedia. The mobile telephone has also become a personal communications tool in that in many households each family member may own their own mobile phone. These changes have affected the fixed

telephony market and have also led to new demands by consumers for value added features in the provision of telephone services.

At the same time as these changes in usage patterns are impacting on fixed telephone operators, new competition has emerged from VoIP and voice over broadband (VOB), further reducing the average revenue from fixed subscribers. These developments have led fixed operators to try and challenge mobile operators. Mobile operators are faced with market saturation in second generation mobile markets and declining average revenue per user (ARPU) in their existing markets. Mobile operators are also faced with competition from voice calls made over the Internet and over Wi-Fi (or Mobile WiMAX such as Sprint-Nextel) networks. This competition is expected to accelerate as an increasing number of new generation mobile terminals incorporate Wi-Fi access capabilities and support VoIP services, such as Skype.

Within this context, FMC is a means for established telecommunications operators to differentiate their services from those provided by low-cost newcomers.[45] Following are some general advantages to a FMC.

From the viewpoint of fixed-network operators:

- Generating new revenue.

- Becoming a one-stop-shop for customers' fixed and mobile needs.

- Defending effectively against mobile substitution.

From the viewpoint of mobile network operators:

- Convincing users sticking to a fixed line to 'cut the cord'.[46]

- Competing with other mobile operators through number portability.

- Reducing the price of mobile calling and access to data using mobile terminals through the provision of cellular/Wi-Fi dual-mode services.

From the viewpoint of both fixed and mobile network operators:

- Shifting to an all IP-based network architecture which will reduce longer-term maintenance costs and allow for the provision of higher value-added services through service bundling.

- Reducing customer churn through bundling and providing the full range of services demanded by customers (one-stop shop).

There is a possibility that FMC services may eventually shrink revenues from the voice market, mainly through the lowering of the price of mobile calls. At the same time new services, including multimedia services, should help to increase ARPU especially when linked with quadruple play offers. With the cost reductions expected through next generation network technology, the profitability of operators could well increase.

## 3-2. *Stages of FMC*

In this section, the various types and stages of FMC are examined. A synopsis is provided in Table 2.

**Table 2. Types and stages of FMC**

● Service bundling
- Bundle of fixed and mobile services
- Bundle of voice (cellular) and data (Wi-Fi) services
- Services such as single voice mailbox offered over both fixed and mobile networks
- Offering discounts for calls made between fixed and mobile networks to specific members

● FMC using broadband /Wi-Fi connections (cellular/Wi-Fi dual-mode service)
- Dual-mode services using a mobile handset and using Wi-Fi modems in the home environment to access VoIP through ADSL connections
  - ADSL through self-provision
  - ADSL through LLU (local loop unbundling)
- Dual-mode services using handsets that do not have a handover function from one mode to another, offering each mode separately
- Dual-mode voice service which has a handover function from one mode to another, but does not utilise a fixed voice or broadband network in the home

● Mobile based 'dual-mode' services

● Network convergence

## 3-2-1. *General trends*

Early offers of fixed-mobile 'convergence' have used bundling of fixed and mobile services without any technological linkage (interface) between the two types of networks. Multiple play offers (including voice, data, video and mobile services) can be included in this category at present. While bundling provides subscribers with discounted prices there is little value-added in terms of new technological features. Vodafone UK, for example, has been reselling fixed voice services wholesaled by Energis and Viatel's DSL for around two years especially for business users.[47]

For cellular services voice and data services can also be bundled, although data service is sometimes through laptops. There is not usually an interface between cellular and Wi-Fi networks (with some exceptions) and those services are not packaged in the way FMC services are offered, since data is regarded as an optional service or may be classified as only for business use. For instance, Cingular in the United States and Swisscom in Switzerland provide mobile voice and Wi-Fi data services individually. Cingular offers voice and data services through mobile handsets and data services through GPRS/EDGE/Wi-Fi embedded laptops. Users can access the Internet with laptops while on the move through Cingular's wireless network and the thousands of Wi-Fi hotspots across the country; in this way, sending and receiving e-mail, browsing the Internet and accessing the company's intranet can all be handled wirelessly. In this example, although data services overlap, they are still provided as different services. Swisscom provides its Wi-Fi service to its business customers specifically but customers subscribe individually to both voice (cellular) and data (Wi-Fi) services.

Services also exist which link both fixed and mobile networks but are not technically converged such as services offering a single voice mailbox over both fixed and mobile networks. In 2003-2004, the United States company Verizon launched a service called iobi forwarding calls between fixed and mobile networks by connecting multiple devices such as PCs and phones. Around the same time, another US company, AT&T (SBC), started providing the same kind of service enabling subscribers to retrieve their e-mail, voice mail and faxes through PCs, fixed line telephones and mobile phones.[48] Sprint in the United States announced that it was forming a partnership with four cable companies (Comcast, Time Warner Cable, Cox Communications and Advance/Newhouse Communications) in order to provide live cable broadcasts over handheld mobile devices.[49] In addition to mobile TV, Sprint seems to be planning on providing a new voice service where calls made to the fixed home cable network can be transferred freely to mobile handsets.[50]

A similar trend can be found in Japan. The Japanese cable company Jupiter Telecommunications (J:COM) announced that it would begin a trial for FMC. The service will allow an existing mobile phone with Wi-Fi functions to transmit a landline telephone signal as an extension of the traditional household landline (cable) telephone.[51]

A number of offers on the market are based on discounts for calls made between fixed and mobile networks to specific subscribers, but are not based on converged fixed-mobile services. As an example, Vodafone in New Zealand bought the fixed network operator ihug in October 2006. Subscribers of ihug's home phone service were offered an unlimited number of calls to one designated Vodafone mobile number for a flat rate.[52]

Telefonica and Movistar in Spain provide a service called 'UNO Familiar' which they see as a step towards FMC.[53] UNO Familiar allows one fixed network subscriber and four mobile subscribers to get a discount for calls made from fixed to mobile, mobile to fixed and fixed to fixed. This service is basically meant to lock-in Movistar's subscribers.[54]

Cellular/WiFi dual-mode service is a popular way of obtaining FMC, and dual-mode handsets are beginning to be provided on the market. That is partly because technology such as UMA can be built on existing networks or can allow operators to use Wi-Fi connected to fixed broadband connections as an alternative low-cost radio access network.[55] An interesting factor is that mobile operators can extend their geographical service coverage in low-density rural areas without installing costly GSM or 3G base stations and can rely on hotspots instead. As an example, in the United States T-Mobile's integrated or converged data services is provided through cellular/WiFi dual-mode handheld devices roaming between GPRS networks and Wi-Fi hotspots while maintaining a data connection.

One survey indicated that 67% of operators (both fixed and mobile) are seeking to offer FMC services, but their approaches differ: 28% of the 67% plan on offering bundled billing, 26% will use IP Multimedia Subsystem (IMS), and 13% prefer UMA.[56] Another study indicated that, in 2005, 58% of Wi-Fi phone revenues came from single-mode Wi-Fi VoIP handsets, and 42% from dual-mode handsets, but that real growth would come from dual-mode cellular/Wi-Fi handsets.[57] With the arrival of cellular/WiFi dual-mode handsets on the market, most US cellular operators may eventually have to include Wi-Fi in their handsets or face the risk of losing their customers to other carriers.[58]

At present there are about 20 UMA trials underway worldwide, 10 of which are taking place in Europe. Operators involved in these trials include TeliaSonera of Denmark, SaunaLahti of Finland, Telecom Italia of Italy and T-Mobile of the United States.[59] Along with UMA-based technologies and handsets, it should be noted that research and development efforts are targeting combinations of 3G, Wi-Fi and WiMAX embedded in handsets.

Cellular/WiFi dual-mode services can be divided into two categories depending on whether they rely on a fixed PSTN voice network or not. Indeed, voice service can be provided either through traditional fixed PSTN networks or through fixed broadband networks (VOB). In some countries, the former seems more attractive to fixed incumbent operators who can then continue using their PSTN voice line while the latter is used by some mobile operators who use their mobile phone services to lock in customers into using their broadband network away from the fixed PSTN networks.[60]

FMC could further hasten the convergence of voice, data and video services in the home environment. Femtocells and other FMC technologies could provide the platform for a significant expansion of household wireless services, enhancing the delivery of triple-play services and extending the reach of carriers beyond basic telecommunications into IT and home entertainment applications. For example, British Telecom in the United Kingdom has recently been promoting its BT Home Hub, which facilitates the integration of broadband, wireless networking, FMC and IPTV services via one device.[61] This kind of model could become widespread in OECD countries.

*3-2-2. FMC using broadband/Wi-Fi connections*

FMC services are being provided at present in a number of ways:

- Dual-mode services using a mobile handset and using Wi-Fi modems in the home environment to access VoIP through ADSL connections: Orange in France provides 'Unik' and Telecom Italia and TIM offer 'Unica' in this way. These are examples of incumbents 'cannibalising' their PSTN traffic. New entrants use the same technology but rely on local loop unbundling (LLU). Examples of offers which fall under this category include Teliasonera in Denmark with 'Home Free', Neuf in France with 'Twin' and Orange in the Netherlands with 'Unique'.

- A less evolved form of service is through cellular/Wi-Fi dual-mode handsets that do not have a handover function from one mode to another, offering each mode separately. One example of this kind of service is Sunrise's 'surf & talk' in Switzerland. A variant of this is a cellular/Wi-Fi dual mode voice service which has a handover function from one mode to another, but it does not utilise a fixed voice or broadband network in the home. An example of this type of service is Hello AS's OnePhone in Norway and T-Mobile's T-Mobile Hotspot@Home in the United States. When subscribers are within the Wi-Fi zone, the calling fee is very low or free, and when calling within the cellular network, the tariff for cellular calls is applied. With this type of service, the switch between the Wi-Fi and GSM networks is handled automatically, with the cheapest route selected.

Cellular/Wi-Fi dual-mode service is becoming more widely available, but other combinations of technology are also possible. One example under study is the cellular/WiMAX dual mode. Sprint Nextel has announced that it wants to build the first national mobile WiMAX network in the United States, giving 100 million Americans wireless Internet access four times faster than currently available through existing high-speed mobile networks by the end of 2008.[62] Allied partners such as Motorola and Samsung are planning on creating multimode devices that switch between mobile WiMax and Sprint Nextel's current CDMA/EV-DO cellular network so that a subscriber's phone or data connection is not dropped as s/he moves.[63]

*3-2-3. Mobile based 'dual-mode' services*

Mobile-based services using home-zones are a variant of FMC. In this case mobile operators offer their customers a virtual fixed line within a designated home-zone area. Tariffs in the home zone tend to be

in line with rates charged by fixed network operators and lower than cellular rates charged outside the home zone.

The main incentive for mobile operators to offer this type of services is that they need to compete with the fixed line operators that are encroaching into the market traditionally reserved for mobile operators through FMC. Another important incentive for mobile operators to offer dual-mode services is to free up valuable licensed spectrum when the customer is within the home zone area. Many of the fixed operators are doing so through MVNOs. At the same time, since many European regulators have required mandatory sharing of mobile networks the number of MVNOs has increased dramatically. Several MVNOs have slashed their costs by abolishing paper invoices and/or by providing customer service by Internet or telephone only. Some have no physical distribution channels and do not sell mobile handsets but only SIM cards. This competition is putting constant downward pressure on mobile voice tariffs and faced with declining ARPU, the mobile companies need to diversify service.
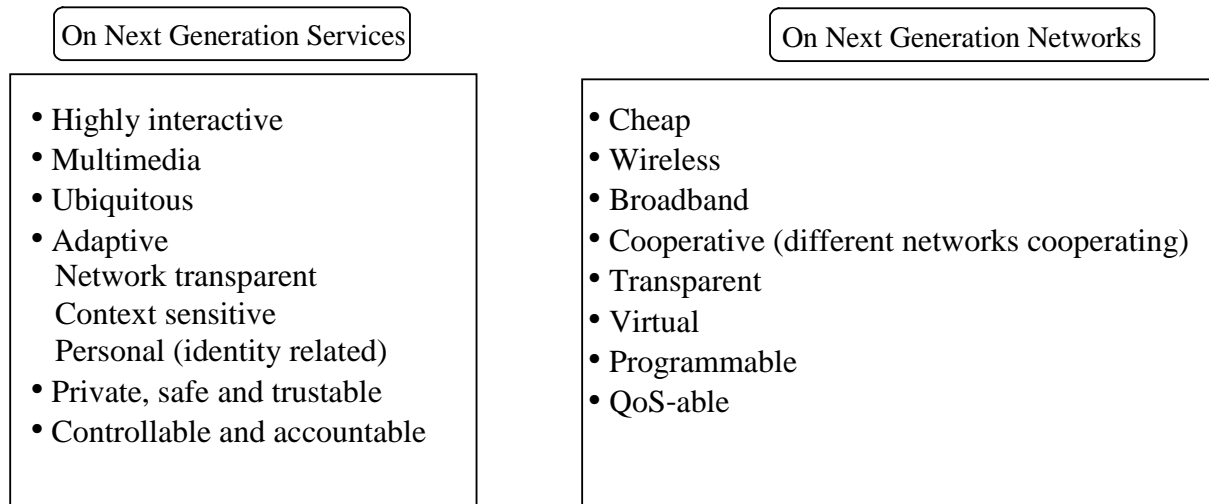
Home-zone type service provisions can also be an alternative for users who live outside broadband coverage areas needed for the provision of FMC services. Although fixed and mobile networks may be complementary in this situation, mobile operators do not seem keen on providing this type of service. Examples of companies who offer home-zone type service provisions include O2 in Germany with its 'Genion'(voice) or 'surf@home' (data), Vodafone in Germany which offers 'Zuhause' and its variants for data services 'Zuhause Web' and 'Zuhause Talk & Web' (business), and T-mobile with 'T-Mobile@home'. In Italy, Vodafone offers 'Vodafone Casa', in the Netherlands, T-Mobile sells 'T-Mobile Thuis', and in Switzerland, Sunrise has 'Sunrise Myzone'.

It is difficult to assess the benefits to mobile operators of providing home-zone type services. On the one hand it expands their market size by including home or business calls made from fixed locations in their potential market. On the other hand many subscribers still use their mobile phones from their homes or offices because of the convenience of having a list of telephone numbers embedded in mobile handsets, or because they have decided not to have a fixed phone. This source of revenue is lost with home-zone service. In addition, some of the home-zone type services set a flat rate in the service package, which is encouraging higher usage by subscribers and affecting quality of service and bandwidth availability. Because of these constraints, some mobile operators are moving into the fixed communication services market, mainly by offering DSL access. For example, Vodafone is expecting to launch its first fixed/mobile service bundle in Germany where it will add a DSL component to its existing 'Vodafone Zuhause' service. The initial offer will be a simple bundle but at the end of the day it will be converged and is expected to capture fixed line voice minutes away from Deutsche Telekom.[64]

IP-based services such as Skype can nowadays be used on mobile networks. The German 3G operator E-Plus started providing voice service at a flat rate using Skype on its network in October 2005. The US mobile manufacturer Netgear started selling handsets for VoWi-Fi with Skype embedded software in August 2006.[65] Although there are very few offers of this kind in the mobile telecommunications world at this time, they represent a challenge to existing operators and can easily impact on their voice revenues. Within such an environment, mobile operators find it difficult to judge when home-zone type services can be introduced and whether these services can be sustainable, while they are at the same time trying to make their networks IP-based in order to make them NGN-compatible.

*3-2-4. Network convergence*

Convergence between fixed and mobile services will depend on a common IP transport network which is IMS-based. FMC, in common with next generation networks, are expected to require the features set out in Figure 5.

**Figure 5. NGN requirements**

| On Next Generation Services | On Next Generation Networks |
|---|---|
| • Highly interactive<br>• Multimedia<br>• Ubiquitous<br>• Adaptive<br>  Network transparent<br>  Context sensitive<br>  Personal (identity related)<br>• Private, safe and trustable<br>• Controllable and accountable | • Cheap<br>• Wireless<br>• Broadband<br>• Cooperative (different networks cooperating)<br>• Transparent<br>• Virtual<br>• Programmable<br>• QoS-able |

*Source*: Andrea Lagana, Telecom Italia, 'UMA, SIP or IMS: which solution should operators consider when offering convergence', 26-27 January 2006, The Fixed Mobile Convergence Conference (London).

The shift to new technology can also be expected to change market structures, in particular: rather than selling calls (voice minutes) as at present, there will be a shift to selling 'connectivity', or access to network resources.

A number of telecommunications operators have announced plans to invest in IMS or NGN (Next Generation Network). Teliasonera in Finland, France Telecom, Telecom Italia, KPN in the Netherlands, NTT, NTT Docomo and KDDI in Japan, BT in the United Kingdom and Sprint Nextel in the United States have all outlined plans to introduce IMS. BT has a goal of terminating its roll-out of its all IP-based network by 2010.[66]

## 4. Policy implications

### 4-1. *Market definitions of FMC*

Defining the parameters of a FMC service or market may be important for regulators who seek to determine whether an operator has market power and whether the operator or operators should be subject to regulation. Finding a clear definition for FMC is not easy. In the context of the EU, for example, where a number of markets have been determined in order to identify whether an entity (or entities) have significant market power in those markets for the purpose of imposing *ex ante* regulations on them, there would be four markets which would cover FMC services:

- Market 3: Publicly available local and/or national telephone services provided at a fixed location for residential customers.

- Market 5: Publicly available local and/or national telephone services provided at a fixed location for non-residential customers.

- Market 8: Call origination on the public telephone network provided at a fixed location.

- Market 15: Access and call origination on public mobile telephone networks.

Precedents are emerging. For example, in Ireland the regulatory agency ComReg opened a consultation in August 2006 to ensure that home-zone type services in Ireland, which a few mobile operators had expressed an interest in providing, should be introduced in the way that best suits Irish consumers. ComReg is expected to issue a response document on its home-zone consultation in early 2007. In Italy, the regulator AGCOM announced it would probe a new trend in FMC services to ascertain whether service providers licensed to operate in just one sector are deviating from their rights by launching joint offers. The probe was opened into all integrated services offered by all operators in the Italian market, but, above all, the probe targeted Telecom Italia's newly launched FMC service 'Unico' and other similar offers.[67] In this approach, the regulator is analysing the service or market within the framework of existing market definitions.

In Japan, it is likely that NTT East and West, the incumbent fixed operators, and NTT DoCoMo, the incumbent mobile operator, will provide a FMC service. This type of service is basically perceived as a benefit for consumers. The Telecommunications Business Law spells out that the former entities are Type I (fixed) designated telecommunications facilities, and the latter Type II (mobile) designated telecommunications facilities and, as a result, regulation is imposed on them as dominant entities. Indeed, the combined market power of the Type I and Type II entities above could hinder competition in both the fixed and mobile markets. Thus, it is conceivable that a review will be needed eventually of the designated telecommunications facilities system. However, the MIC, the Japanese regulator, intends not only to focus on the existing framework but also to review it comprehensively. In other words, it will demarcate markets based on the competition review system, recognise market dominance within and/or between layers in each market, and designate telecommunications facilities subject to opening access and/or applying conduct regulations to operators with a market-dominant position.[68]

As services and markets change in response to consumer demands and technological advances, regulators may need to ensure that their policies are technologically neutral. This neutrality is ensured in the context of the EU's market analysis and in some OECD member countries such as Canada.[69]

### 4-2. Numbering related issues

When it comes to discussing a FMC service, the allocation or classification of the scarce pool of phone numbers is a critical issue for regulators that have allocated geographic phone numbers to fixed network services and nomadic numbers to mobile network services. FMC services, however, are a combination of the two.

There are three basic ways in which this numbering problem is addressed: mobile numbers are maintained; mobile and fixed numbers co-exist; or a new numbering framework is introduced. These solutions can either be developed from the businesses when launching a service or imposed by the regulator.

In the case of BT's Fusion service in the United Kingdom existing numbering systems are maintained. Both BT and its allied mobile operator Vodafone have a location information management system which is normally managed by mobile operators[70] and, as a result, adjustments are ensured in such a way that a call is terminated at a fixed network rate indoors and at a mobile network rate outdoors. Another example in this category is Orange's Unik in France. It offers one mobile phone number, but calls can be transmitted only from the Wi-Fi to the mobile network and not *vice versa*. That means that within the subscribers' home, calls cannot be terminated via Wi-Fi but via the mobile network.[71]

Fixed and mobile numbers can co-exist. ComReg's proposal in Ireland for home-zone type services is that with the home-zone, mobile customers are provided with both a fixed and a mobile telephone number for a single mobile handset. Those who call a home-zone service subscriber's geographic number will

know where the called party is located by looking at the number dialed. If a calling party dials the fixed number that has been provided to the home-zone subscriber, tariffs for the call would be at the fixed line rates. In terms of service, if the subscriber is out of the home-zone area, the call can be transferred to voicemail or optionally be call-forwarded, at the home-zone service subscribers' discretion, and at their expense.[72] Home-zone subscribers will be provided with a number corresponding to the area where their homes or offices are located. The subscribers' addresses can also be used by the mobile operator when providing supplementary services such as voicemail. In addition, ComReg also indicated that if subscribers move to another numbering area, they would not have to give up their well-established geographic numbers through the automatic location portability that would exist in a mobile operator's home-zone area.[73]

For FMC, a new numbering framework can also be used. MIC in Japan regards a FMC service as a 'one number and one call' service. In the longer term it would seem that this should be the objective of FMC in that the purpose of FMC services is to provide customers with a 'one-stop' calling service irrespective of the network being used. Customers want to receive and make calls from fixed locations, want to have the ability to roam and call when moving at higher speeds.

MIC in Japan recommends that[74]:

- New special numbers (060) should be introduced.

- Existing nomad numbers such as the ones for mobiles (080 or 090), for PHS (070) and for IP phones (050) may be used as far as this does not have a strong impact on existing services.

MIC will examine the ways in which operators may apply for a new number and will decide how to determine which type of FMC service can apply for the existing numbers. Just as in Ireland, consideration needs to be given to the transparency of fees. Regarding the introduction of a new number range, it would also be taken into consideration that consumers will face the possible confusion of having to deal with yet another range and that additional costs may be involved for industry in implementing the new number range.

If new numbers or existing nomad numbers are utilised in FMC service, those who make calls to these FMC services need to be informed (where there is a calling party pays system) whether there are differential charges for calls made to the FMC subscriber depending on their location. In a receiving-party pays framework this does not raise concerns. The tariffication issue will become important in the context of FMC services. One solution may be to impose a charge on the subscriber of the FMC service rather than try to inform the calling party that the call being made will terminate on a fixed or mobile network.

Most OECD countries now have implemented number portability for fixed networks and only a few have not yet done so for mobile number portability. In the context of the development of FMC services and allowing for inter-modal competition, it could be important to allow for portability of geographic numbers from fixed to mobile networks with a greater certainty for consumers. Identifying the number easily also does not require callers to contact directory services to find the new number of subscribers to FMC services. Inter-modal number portability is possible in Canada and in the United States where fixed and mobile numbers are within the same geographic numbering plan. In the United States, wireless carriers in the largest metropolitan statistical areas and in smaller markets across the country are required to guarantee local number portability, including fixed to mobile portability.[75] In November 2003, the Federal Communications Commission (FCC) implemented wireless local number portability, eliminating a barrier to full competition in mobile telephone services and between landline and wireless services. American consumers are now able to change phone companies, wireless-to-wireless, wireless-to-wireline or wireline-to-wireless, within a local area, and keep their phone number. Previously, consumers wishing to change

wireless carriers were required to get a new number from the new phone company, which often deterred consumers from changing carriers. In the first year of implementation, more than 8.5 million consumers took advantage of wireless local number portability. Just under 10% of those consumers 'cut the cord' and moved a landline number to a wireless phone. In the first year, consumers have ported more than twice as many numbers among wireless carriers as consumers did among landline carriers in the first year that landline local number portability was available. In Denmark, total portability, including between fixed and mobile networks, was to be introduced,[76] and the plan will be examined by the National IT and Telecom Agency in 2008 although there were concerns about the ability of operators to differentiate tariffs for international inbound calls terminating on fixed and mobile networks, and about the removal of indications in numbers that provide terminated call pricing information for callers.[77]

On the other hand, in the United Kingdom, Vodafone asked BT to provide the portability of geographic numbers from fixed to mobile networks. Ofcom, the British regulator, determined that BT did not have an obligation to provide this; however, Ofcom intends to modify the Number Portability General Condition and the National Telephone Numbering Plan for the purpose of facilitating inter-platform voice competition.[78] This is reflected in Ofcom's strategic review of telecommunications in which the regulator examined how to ensure competition at the infrastructure level as technology progresses.[79]

It can also be argued that number portability is not only an important issue but also linked to the future of numbering plans and to the related issue of directory services and peering. IMS supports SIP calling and could therefore support SIP numbering or other schemes for calling, given that IP based networks will be platforms for communication. In addition, it will be important to determine how emergency calls can be treated, in particular to make location information available, when only the Wi-Fi system is available when using a dual cellular/Wi-Fi system.

### 4-3. Universal service related issues

A fund for universal service is an important tool to deploy standard fixed telecommunications services, especially in rural areas where coverage may not be profitable. The market players contributing to such a fund differ from country to country. In certain cases, it is only the fixed operators, whereas in other countries it is all operators including entities having carrier licences on a technology–neutral basis (and meeting an eligible revenue threshold) for example in Australia where they are allowed to own and operate both fixed and mobile networks. Clearly as fixed-mobile seamless services develop, thought should be given to extending the obligation of contributing to a universal fund to players in the FMC market and perhaps mobile players as well, in order to ensure that no market distortions arise through the imposition of costs only on some market players. Regulators also may wish to consider whether all market players having universal service obligations should be eligible to receive, or compete to receive, universal service funds. For example in the United States, since the Telecommunications Act of 1996, competitive carriers, including wireless carriers, are eligible to receive universal service support. This policy, however, is currently under review in the United States. On the other hand, at present, there are some countries where only an incumbent fixed operator receives all benefits.

Within the context of the European Union, for example, the universal service fund is shared 'between providers of electronic communications networks and services'[80] and is thus supposed to be financed by all operators, including mobile operators. The universal service providers are at present only fixed incumbent operators in the EU countries where the universal service providers have been designated.[81] The issue of whether mobile operators should contribute and be part of universal service frameworks has recently been raised in the EU context.[82] However, if universal service obligations are extended, this should allow all market players to have an opportunity to benefit from universal service funds and not only, as is the case in some countries, to pay into funds.

### 4-4. Price regulation issues

Many OECD countries use price regulations such as price caps, or wholesale price regulation, which either cover the retail prices of basic telecommunications services relating to a universal service offered by the incumbent fixed operators, or to a network element (local loop) required by a new entrant to provide service. In some countries mobile operators are subject to price regulation, usually for wholesale prices but in some instances for retail prices. For example, in the United States, retail prices for wireless providers, non-dominant domestic and international long-distance carriers are deregulated. Competitive local exchange carriers are subject to permissive detariffing, in which they are permitted to file tariffs for certain services, but are not required to.

Although the basis for any price regulations within the European Union, for example, is the process of market definitions or significant market power assessment and resulting remedies imposed on dominant operators, the development of FMC services may make it necessary for regulators to forbear from price regulation since price regulation may distort competition, especially if it is only imposed on fixed telecommunication providers while new entrants are free from any regulation. Since FMC services will lead to bundled prices and are intended to decrease charges to consumers by using fixed networks in the home or setting a cheap home-zone through mobile services, price regulation may be inappropriate.

However, in view of the use of bundling and the possibility of market players leveraging dominance in one market to gain advantage in other markets, it is important that price surveillance be maintained. In Canada it has been proposed that filing of tariffs for bundled services should be required instead of prior approval, and these may be challenged *ex post* if there are grounds that they result in anti-competitive conduct.[83]

Any asymmetric price regulation at the retail level could result in some market distortions and would require careful consideration. The recent tendency to lift retail price regulations, such as proposals in Canada, is a step in this direction.

### 4-5. Interconnection issues

The fixed subscriber line market has traditionally been dominated by incumbent operators. They have been subject to interconnection requirements usually at rates determined by the regulator or through a methodology set by the regulator. Mobile termination rates were in many cases determined in the market but have increasingly been subject to regulation and requirements to be cost-oriented. For fixed-to-mobile interconnection the custom across OECD countries varies. In many cases these are commercially negotiated but may be subject to regulatory intervention if parties cannot reach agreement. In other cases, fixed-to-mobile interconnection is required to be cost-oriented because mobile operators have been designated as having market power. For example, in the United States, mobile networks operate under a mobile-party-pays regime, although other settlement arrangements are permitted, and termination payments are carrier-to-carrier payments, not payments by users. Termination rates for mobile-to-mobile calls are not regulated, and most mobile operators use Bill and Keep arrangements. However, interconnection rates between dominant carriers, the incumbent local exchange carriers (ILECs), and other carriers – including mobile operators – are regulated. ILECs and mobile operators interconnection rates fall under the FCC's 'reciprocal compensation' rules for calls deemed 'local', which require that the rate the ILEC charges the mobile operator for termination equal the rate that the mobile operator charges the ILEC for termination, unless the mobile operator can prove that its costs are higher than the costs of the ILEC.

Differences in regulatory treatment of interconnection and fixed-mobile termination rates could create distortions in a FMC service. ComReg, the Irish regulator, indicated its concern that, in reference to providing home-zone services, mobile operators might impose high termination charges on the originating fixed-line operator.[84]

Arguments have been put forward for introducing a 'Bill and Keep Model', where the call originator and the recipient of the call each respectively pay for the costs of originating and terminating the call, thus replacing existing interconnection systems for the purpose of eliminating the complexities or asymmetries between fixed and mobile networks (see Figure 6.).

One of the advantages of the 'Bill and Keep Model' is that operators can demand fees corresponding to their network costs. If network costs are expensive, operators will end up passing on the cost of inefficient portions of their network to their customers, which will disadvantage them in a competitive market. The model, therefore, assumes that there is a certain degree of competition in telecommunications markets and that price signals influence the behavior of customers, although it can be applied to a local monopolistic market.[85]

One objection to the 'Bill and Keep Model' is that it is not economically efficient when traffic between networks is out of balance, since the originating network causes the terminated network with the net inflow of traffic a cost which it would otherwise not incur. However, some argue that, as the FMC service is introduced, the use of the 'Bill and Keep Model' will increase the efficient use of networks by consumers. That is because subscribers using converged devices will receive calls by way of both higher cost cellular mobile networks and lower cost fixed networks, and thus the called party will know much more about the cost of receiving the call than the caller, and as a result will have more information with which to act in an efficient way by using services such as refusing calls or curtailing calls.[86]

Whether the 'Bill and Keep Model' can be introduced or not depends on a number of conditions. In assessing whether to move to a 'Bill and Keep Model', regulators should consider the following factors: the probability that incumbent operators with significant market power will set excessive retail tariffs; whether competition is sufficient to constrain the mark-up of network costs; and, especially in the United States, how to deal with small incumbent operators who will lose interconnection charges - one of their main sources of revenues.[87]

**Figure 6. 'Bill and Keep' Model**
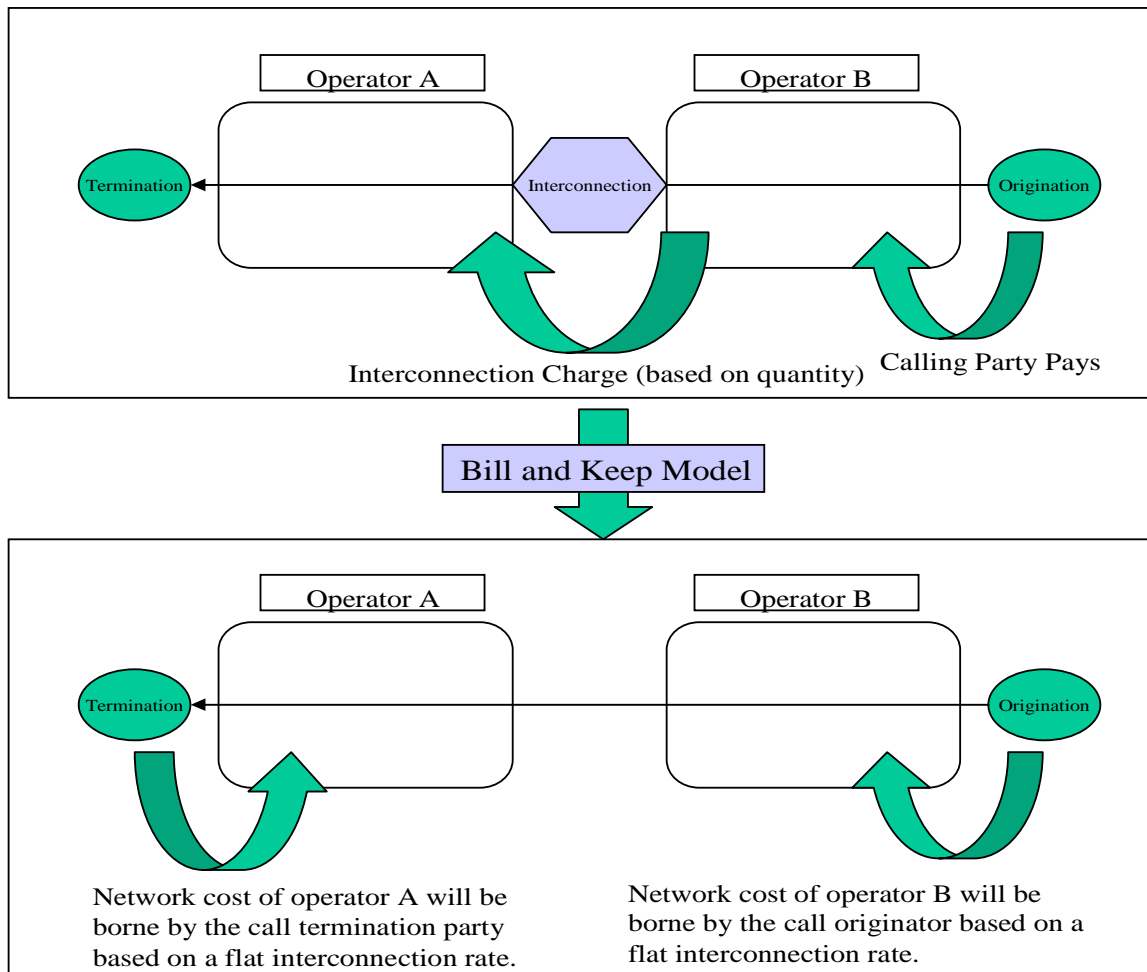


*Note*: Calling party pays is not always applicable to all member countries since the United States, for example, adopts receiving party pays.

*Source*: Yasuhiko Taniwaki (2005) 'Converging Network', Kanki: 125. The work of Benjamin E. Hermalin and Michael L. Katz, or Jean-Jacques Laffont and Jean Tirole is also relevant.

## *4-6. Licensing issues*

Within the EU context, individual licences for fixed or mobile services are being replaced by less onerous entry procedures such as a general authorisation. With this scheme, those who want to 'provide electronic communications networks and services' are generally authorised to do so, although the regulator can attach some conditions to the general authorisation.

General authorisation frameworks in a number of countries encompass fixed and mobile services, although for mobile services licences may be required for use of spectrum. Limitations on licensed spectrum have led to the use of MVNOs by fixed operators that do not have a mobile subsidiary or cannot obtain access on commercial terms to the resources of a mobile operator. It thus may be important for the development of FMC in some countries to require mobile operators to provide MVNO access on reasonable terms. Providing mandated access should not be necessary in markets where mobile operators are competing vigorously; in such markets, competition should guarantee reasonable access to resellers. Moreover, in cases where mandated access may be necessary, care would need to be taken that the terms of access do not create a disincentive to invest in the facilities-based mobile networks. More flexibility,

especially in terms of technologically neutral spectrum allocations, in spectrum allocation, and secondary markets for spectrum will also provide more possibilities for fixed operators to obtain the necessary spectrum resources to provide FMC services [See 'The Spectrum Dividend: Spectrum Management Issues' (DSTI/ICCP/TISP(2006)2/FINAL)].

At present regulations affecting MVNOs are generally as follows:[88]

- Specific regulatory provisions for MVNOs; *i.e.* procedures to obtain a 'licence' have been put in place in a number of countries – market entry provisions.

- Regulatory intervention which requires MNOs (Mobile Network Operators) to provide access to their networks – provisions aimed at developing competition in the mobile market.

- Reliance on commercial negotiations where the regulator may intervene if agreement cannot be reached between MNOs and MVNOs.

MVNOs have flourished in countries such as Denmark, the United Kingdom and the United States. In France, there are 15 MVNOs doing business, and while their share of the market is still limited to 1.46 %, between June 2005 and June 2006, their number of subscribers grew from 41 000 to 700 000.[89] In the United States, MVNOs typically offer prepaid plans rather than standard monthly billing and develop unique service offerings targeted to niche demographics traditionally ignored by larger carriers. There are now more than two dozen US MVNOs focusing on groups of individuals who lack traditional wireless service, such as people who are credit-challenged, teenagers, and those who want a mobile phone for limited use.[90]

### 4-7. Competition related issues

Where they can obtain single billing and have access to one-stop shopping, customers often prefer to obtain service from the same operator. This facilitates bundling, especially by fixed service incumbents who have, in most OECD countries, a mobile service operator. In that in most OECD countries the incumbents already have market power (and often their mobile operator is also the market leader), the development of FMC can augment this market power. It is thus important for regulators to develop adequate market tests to examine the market in order to take action where necessary to develop or maintain competitive markets. In this regard, in Italy the regulator AGCOM is planning on introducing a compulsory margin squeeze test for bundles to ensure that Telecom Italia does not leverage its dominance in the fixed voice market to get market share in other markets, and to guarantee that competitors can replicate the new offer economically. AGCOM also only permitted the bundling of services which can be bought separately by customers.[91]

In Japan, to ensure fair competition in FMC services the regulator MIC has decided that with respect to NTT East and West (the incumbent fixed operators) and NTT DoCoMo (the incumbent mobile operator) there are three categories:[92]

- 'Interconnection between operators': NTT East and West, and NTT DoCoMo have to let competitors interconnect with the same conditions as when they interconnect with each other.

- 'MVNO usage': NTT DoCoMo as a MNO is required to provide wholesale access to its network to MVNOs including NTT East and West on the same conditions.

- 'Shared use of telecommunications facilities': This is not permitted. Operators are required to construct their own networks.

Japan is advanced in availability of FTTH service and some FTTH service providers, other than NTT East and West, have concerns with the provision of FMC service. K-OPTI.COM, which is a FTTH service provider owned by electricity companies and a competitor to NTT East and West, insists that if NTT East or West and NTT DoCoMo ally in starting a FMC service, other mobile operators will have to follow suit and ally with NTT East and West, while K-OPTI.COM, which only provides FTTH, will not be in a position to provide this type of service as quickly as the NTT groups. In this context the various companies are not on an equal footing.[93]

In Italy, operators having significant market power are not permitted to share information between their fixed and mobile divisions. In Denmark, there are some measures to make sure that information that goes to a unit in the incumbent company is also given to other companies in the market. In practice this is handled by setting up a demand for non-discrimination between internal units and other operators and by setting up a demand for notice of new initiatives and for transparency. In the United States, all operators are subject to regulations in the sharing of information between their fixed and mobile operations. The United States also has put regulations in place requiring that operators obtain their customers' approval before marketing mobile services to them based on in-house information on their fixed network usage.[94] It would be difficult to require this type of regulation in a FMC market where the fixed and mobile operations of the operator have been fully integrated.

The increased availability on the market of 'naked' DSL offers may help lower prices for FMC services and may stimulate its availability. With 'naked' DSL the subscriber does not pay for, or receive, a PSTN voice service. The subscriber only pays for a broadband ISP access service and a FMC subscription charge using VoIP in the home-zone. Only a few OECD countries have regulations requiring the incumbent to offer 'naked' DSL.

In the context of the development of next generation networks, arguments have been put forward that with FMC services, the 'layers model' (see Figure 7.) should be used.[95] In other words, the terminal layer should not be controlled or dominated by the neighbouring network layer or, since the terminal layer can have intelligence functions, such as for controlling services, the network layer should not be controlled by the terminal layer. Ensuring openness of the interfaces between individual layers can facilitate competition.

**Figure 7. Layers model**
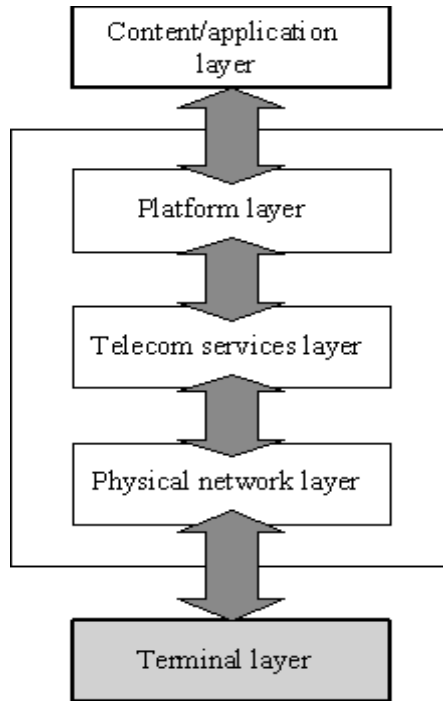


*Source*: 'Draft Report of the Study Group on a Framework for Competition Rules to Address the Transition to IP-Based Networks 'New Competition Promotion Program 2010'', MIC Japan, July 2006: 28.

ANNEX

**Service patterns and tariffs in selected OECD countries**

This section will examine service patterns and tariffs in a selection of countries including VoWi-Fi. Countries where several competing operators exist such as France, Germany, Italy, the Netherlands and the Untied Kingdom will be looked at first.

Service patterns are varied but comparison of the monthly charges for unlimited local fixed calls from home using FMC is as follows.

**Figure Annex 1. Monthly charges for unlimited local fixed calls from home using FMC
(as of October 2006)**
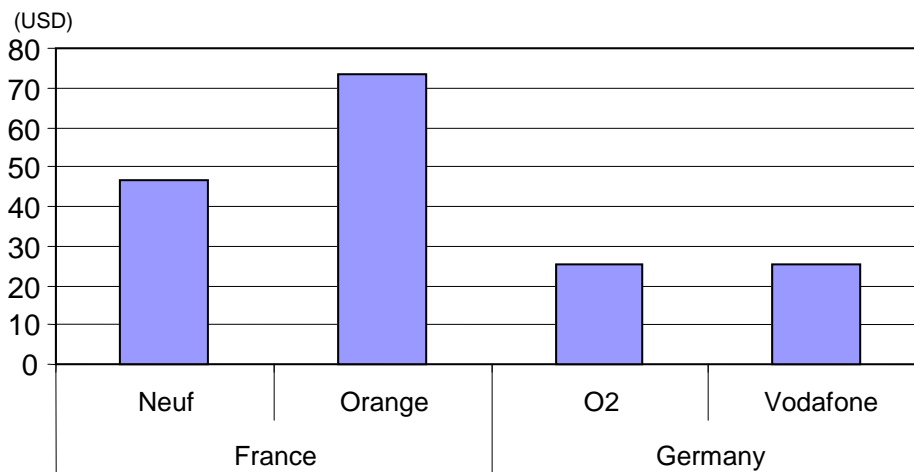


*Notes*: (1) Neuf: combination of ADSL and Twin's monthly tariffs.
(2) Orange: combination of ADSL, Orange mobile and Unik's monthly tariffs.
(3) O2: Genion's *Flatrate für die Homezone* (monthly).
(4) Vodafone: Zuhause (flatrate) (monthly).

*France*

**Table Annex 1. Tariffs of FMC services in France**

| Operator | Types | Monthly tariff | Local fixed call tariff |
|---|---|---|---|
| Neuf (*1) | Twin 1h 30 (also available for services from 2 to 12 hours of mobile calls) | EUR 21.90 (USD 27.72) | [Within the home or Wi-Fi access points(*2)]<br>Free<br><br>[Outside of the home or Wi-Fi access points(*2)]<br>Subject to calling minutes' endowments<br><br>[Free options]<br>Either unlimited SMS to all mobiles or unlimited calls to all Neuf mobiles can be chosen. |
| Orange (*3) | Unik Option unlimited to fixed phones | EUR 10 (USD 12.66) | [Within the home(*4)]<br>Free |
| | Unik Option unlimited to fixed phones and to Orange mobile | EUR 22 (USD 27.85) | [Within the home(*4)]<br>Free<br>(also free to orange mobiles) |

*Notes*: (*1) It requires a subscription to 'ADSL 20 Mega' (EUR 14.90 (USD 18.86)/month).

(*2) At Wi-Fi access points, calls are free and unlimited to fixed networks in France or in selected countries. There are 50 000 Wi-Fi access points in the world and 3 000 in France.

(*3) It requires a subscription to 'ADSL Orange Internet 1 megamax ' (EUR 24.90 (USD 31.52)/month) at least. It also requires an Orange mobile subscription.

(*4) Mobile Unik should be connected to a Livebox.

Neuf and Orange both offer a voice service. Orange estimates that around 40% of mobile calls are made from home and 30% from the office, so if customers set up a WLAN at either site, they will save money on their phone bills.[96] At present, Unik cannot be used in Wi-Fi hotspots, while Twin is available in 3 000 hotspots in France. There is speculation that Unik will be available in Orange hotspots in the near future.[97]

Subscribers of Neuf's Twin will have two numbers while subscribers of Orange's Unik will have one mobile number. As a result, Twin's calls will be cut when users leave their homes.[98] On the other hand, Unik ensures automatic call transmissions only from the Wi-Fi network to the GSM network and not the other way around.[99]

SFR, another competitive mobile operator, has signed a contract with Nokia in order to enhance network coverage and capacity. By modernising its network, SFR will be able to upgrade its current circuit switched core network to a FMC enabling system.[100] In addition, SFR announced that it would start a trial of a home-zone type service which would offer unlimited calls to all French fixed wirelines if they are made on an SFR handset in or near the customer's home. This 'Happy Zone' option, which will be sold from 2007, will reportedly cost EUR 15 (USD 18.99) per month and have the advantage of not requiring customers to buy a new handset.[101] Free, the ISP in France, is also reportedly aiming at offering a FMC service and is thus allying itself with vendors dealing with softswitch and cellular/WiFi dual-mode handsets.[102]

*Germany*

For voice FMC services, O2, Vodafone and T-Mobile are competing in the field of home-zone type service provisions. O2 and Vodafone also cover data services, while T-Com does not offer net-surfing service but SMS or MMS services.

**Table Annex 2. Tariffs of FMC (voice) services in Germany**

| Operator and service | Monthly tariff | Local fixed call tariff |
|---|---|---|
| T-Com One Talk 25 (*)<br>(inc. 25 free calling minutes)<br>(also available for services from 50 to 200 free calling minutes) | EUR 10 (USD 12.66) | EUR 0.39 (USD 0.49)/minute (beyond free calling minutes; also applied to mobile terminated tariffs beyond free calling minutes) |
| O2 Germany Genion | EUR 9.99 (USD 12.65) | [Within home-zone]<br>EUR 0.03 (USD 0.04)/minute<br>[Outside of home-zone]<br>EUR 0.49 (USD 0.62)/minute |
| O2 Germany Genion *Flatrate für die Homezone* | EUR 19.98 (USD 25.29) | [Within home-zone]<br>Free (also free to the O2 Germany network) |
| Vodafone Zuhause | EUR 5 (USD 6.33) | [Within home-zone]<br>EUR 0.04 (USD 0.05)/minute |
| | EUR 20 (USD 25.32) | [Within home-zone]<br>Free (also free to the Vodafone Germany network) |
| T-Mobile@Home (Single Option) | EUR 4.95 (USD 6.27) | [Within home-zone]<br>EUR 0.04 (USD 0.05)/minute |
| T-Mobile@Home (Family & Friends Option) | EUR 4.95 (USD 6.27) | [Within home-zone]<br>EUR 0.04 (USD 0.05)/minute<br>(Inside the home-zone, calls among families or friends are free.) |

*Note*: (*) 'T-Com One Talk' requires a fixed PSTN network subscription (EUR 15.95 (USD 20.19)/month), a DSL subscription (*e.g.* T-DSL2000 (EUR 19.99 (USD 25.30)/month), 'T-Online DSL telephony flat rate' (EUR 9.95 (USD 12.59)/month) and 'Hotspot call' (EUR 4.95 (USD 6.27)/month).

T-Com's T-One is the first joint product between T-Com and T-Online since the merger of T-Online with Deutsche Telekom.[103] Users can use the T-One phone at home like a fixed-phone, make calls at T-Com and T-Mobile hotspots in Germany and use the handset like a mobile phone elsewhere. As with other dual solutions, the key selling points are one device, one mailbox, one address book and one bill.[104] Subscribing to T-One requires subscriptions to a fixed PSTN network, a DSL based on the PSTN, a VoIP (flat rate) telephony and a Wi-Fi usage, therefore subscribers will need to pay around EUR 50 (USD 63) per month in addition to the package price. This service is only based on the GSM network at present.[105]

The tariffs applied for home-zone type services by O2 and Vodafone are quite similar. They have a basic and a flat rate service, although the coverage of the flat rate service varies. Flat rate services are applied to calls made within their own networks as well as to calls made to the local fixed network. With reference to flat rate calling charges to local fixed network, O2 is almost the same as Vodafone.

Vodafone's 630 000 Zuhause customers generated EUR 80 million (USD 103 million) in revenues in the past year, and the company has set a target for the end of the current financial year (ending 31 March 2007) of 2 million users generating EUR 240 million (USD 309 million) in sales. T-Mobile managed to attract around 700 000 customers in the seven months after the launch of its @Home service.[106] T-Mobile offers a 'Family & Friends Option' which enables up to four additional users to make calls to one another at fixed-line rates. Within the home-zone, such calls are free of charge.

**Table Annex 3. Tariffs of FMC (data) services in Germany**

| Operator and service | Monthly tariff | Tariff within endowed volume | Tariff beyond endowed volume |
|---|---|---|---|
| O2 Germany Surf@home Volume 500 (500 MB) (also available for services of 1 000 MB and 2 000 MB) | EUR 19.98 (USD 25.29) (*) | EUR 0.04 (USD 0.05)/MB | EUR 0.15 (USD 0.19)/MB |
| Vodafone Zuhause WebOption | EUR 5 (USD 6.33) | [Within home range] EUR 0.04 (USD 0.05)/minute [Outside of home range] EUR 0.186 (USD 0.235)/minute | |
| Vodafone Zuhause Web Time/Volume (5 000 MB) | EUR 29.95 (USD 37.91) | EUR 0.006 (USD 0.008)/MB | [Within home range] EUR 0.25 (USD 0.32)/MB [Outside of home range] EUR 1.86 (USD 2.35)/MB |

*Note*: (*) Monthly tariffs of O2 Germany Surf@home services include 'monthly basic tariff (EUR 9.99 (USD 12.65).

O2 Germany, is taking a different approach in combining different technologies in order to converge services and maximise ARPU and overall value. It tried to enhance Genion when its German arm teamed up with Deutsche Breitband Dienste (DBD) by launching SmartDuo, which combines fixed broadband services using WiMAX with mobile phone and home phone connections.[107]

*Italy*

**Table Annex 4. Tariffs of FMC services in Italy**

| Operator | Service | Monthly tariff | Local fixed call tariff |
|---|---|---|---|
| Telecom Italia, TIM | Unica (*1) | EUR 15 (USD 18.99) (*2) | [Within the home] • 900 minutes/month (100 minutes/month to TIM national mobile network) with a TIM Unico • Free national fixed call with a home fixed line |
| Vodafone | Vodafone Casa Zero(*3) (also available for 'Vodafone Casa Infinity') | EUR 9.99 (USD 12.65) | [Within the home] • Up to 1 500 minutes EUR 0.15 (USD 0.19)/call |

*Notes*: (*1) It requires for subscribers to pay a fixed line rental fee to Telecom Italia, to subscribe to TIM mobile services, to install 'Alice Voice' in Wi-Fi, and to get up to 5 TIM Unicos (handsets). Therefore the TIM Unico Pack is necessary, which costs EUR 369 (USD 467) and contains a TIM Unico handset, a modem of wireless gate and a modem of ADSL 2+ etc.

(*2) It requires payment for an additional TIM Unico handset (EUR 5 (USD 6.3)/month) if subscribers want it. It is allowed to add up to 5 handsets.

(*3) 'Vodafone casa Zero' has been temporarily authorized by the Ministry of Communications (until 14 February 2007) and up to a limited number of users (15 000).

'Unica' is a combined service provided by Telecom Italia and TIM which ensures calls from a Wi-Fi network (provided by Telecom Italia, together with its ADSL offering) at home, and uses TIM mobile handsets Unico while subscribers are nomadic. 'Unica' requires a PSTN fixed network, ADSL broadband and a TIM mobile subscription. Vodafone Casa Zero or Casa Infinity is a home-zone type service. These offers do not provide data access although that is likely to change since Vodafone Italia is launching a Super UMTS Broadband service with a download speed of 1.8Mbit/s, which is four times faster than the present UMTS speed.[108]

Vodafone announced that from the beginning of 2007 it would launch a new service whereby its customers can use their fixed line number on their mobile phones without subscribing to Telecom Italia's fixed line. The service enables customers to receive calls made to the fixed number of their choice on their mobile phone while they are at home, and to be able to choose up to two mobile phone numbers on which to receive calls. When the customer is not at home, s/he will be informed of the call via SMS or can activate an answering service. This service is intended to compete with its rival Telecom Italia's Unica.[109]

AGCOM, the Italian regulator, has a consultation document on the regulatory issues stemming from FMC. The information received during the consultation phase will be used to shape the regulation of converged (or integrated) services such as those provided by Vodafone.

*Netherlands*

**Table Annex 5. Tariffs of FMC services in Netherlands**

| Operator | Service | Monthly tariff | Local fixed call tariff |
|---|---|---|---|
| Orange | Unique(*1) | - | [Within the home] EUR 0.06 (USD 0.08)/call + EUR 0.025 (USD 0.031)/minute |
| | Unique (extra voordelig bellen)(*1) | EUR 10 (USD 12.7) | [Within the home] Free (including calls to Orange mobile in the Netherlands) (*2) |
| T-Mobile | Thuis Basis | EUR 6.95 (USD 8.80) | [Within the home] Peak (*3): EUR 0.06 (USD 0.08)/call + EUR 0.04 (USD 0.05)/minute Off-peak: EUR 0.06 (USD 0.08)/call + EUR 0.02 (USD 0.03)/minute |
| | Thuis Plus | EUR 16.95 (USD 21.46) | [Within the home] Free (*4) |

*Notes*: (*1) It requires an Orange mobile subscription ranging from EUR 15 (USD 19) to EUR 150 (USD 190) per month and an Orange ADSL Family with Livebox, which costs EUR 26.90 (USD 34.11) per month.

(*2) Limited to 2 500 minutes per month.

(*3) Peak time is from 8:00 to 19:00.

(*4) Limited to 3 000 minutes per month.

Orange's Unique service follows the French version and started in October 2006. This service is characterised by providing one phone, one phone number and one address book. Within the home, thanks to the wireless network by Livebox, five mobile phones can be used simultaneously. This service does not need a fixed voice network subscription, only the fixed broadband service offered by Orange.[110] There are two types of mobile handsets at present which costs EUR 15 (USD 19) per month. T-Mobile started to offer a home-zone type service in October 2006 and also aims to attack on home landlines.[111]

*United Kingdom*

**Table Annex 6. Tariffs of BT's Fusion**

| Operator and service | Plan | Monthly tariff | Local fixed call (evening & weekend) | Local fixed call (daytime) |
|---|---|---|---|---|
| BT Fusion 100 (100 minutes calling time) (also available for services of 200 and 400 minutes calling time) | Landline plan | GBP 20 (USD 38) (*1) | GBP 0.055 (USD 0.104)/hour (*2) | GBP 0.03 (USD 0.06)/minute (*2) |
| | Evening & Weekend plan | GBP 23 (USD 43) (*1) | Free | do. |

*Notes*: (*1) Monthly tariffs vary based on contract duration. The cheapest monthly tariff has been chosen.

(*2) Tariffs are applied up to 1 000 minutes per month. Beyond the limitation GBP 0.1 (USD 0.2)/minute will be charged.

Fusion is based on the 'utilisation of fixed PSTN voice network in the home (building)', which is different from the BT Total Broadband service or the Orange service. BT's Fusion was reported to have about 30 000 customers in May 2006, 9 months after its launch.[112] In the home (building) transmissions between mobile handsets and fixed PSTN network are at present handled via Bluetooth, but BT plans to introduce Wi-Fi capability sometime in 2006.[113] BT reportedly has also plans to add mobile WiMAX to its Fusion service.[114]

**Table Annex 7. Tariffs of other complementary FMC services in the United Kingdom**

| Operator (and service) | | Monthly tariff | Evening and weekend (plan) | Anytime (plan) |
|---|---|---|---|---|
| BT Total Broadband (*1) | Option 1 | GBP 17.99 (USD 33.94) (*2) | [Evening (*3) and weekend calls to UK landline network up to an hour] | [Calls to UK landline network up to an hour] |
| | Option 2 | GBP 22.99 (USD 43.38) (*2) | | |
| | Option 3 | GBP 26.99 (USD 50.92) (*2) | Free [Daytime calls to UK landline network] GBP 0.03 (USD 0.06)/minute | Free |
| Orange | | - (*4) | [Off-peak (*5)] Free [Peak] GBP 0.025 (USD 0.047)/minute | Free |

*Notes*: (*1) Options are based on the quantity of attached services.

(*2) The 'Anytime' plan requires GBP 4.95 (USD 9.34) per month in addition.

(*3) From 6 p.m. to 6 a.m.

(*4) Orange mobile pay monthly customers with a talk plan over GBP 30 (USD 57) are supposed to get this service for free, which is worth GBP 17.99 (USD 33.94). In the case of the 'Anytime' plan, it requires GBP 6 (USD 11) per month in addition.

(*5) From 6 p.m. to 8 a.m.

BT has also launched a bundled offer called Total Broadband. The optional packages offer download speeds of up to 8Mbit/s, depending on distance from the exchange, via the BT Home Hub wireless router. These packages comprise VoIP calls in the evenings and during weekends and 250 BT Open Zone Wi-Fi minutes, which are included in the monthly tariff. The system could also be set up to support BT's Fusion service, which integrates GSM and Bluetooth into a single device.[115] 'Fusion' handles only voice service, and 'Total Broadband' offers data services as a complementary product.

Orange provides a similar service to BT's Total Broadband. Its Livebox wireless modem lets subscribers connect to up to six computers in the home and surf everywhere at home with no wires. Its broadband speed goes up to 8Mbit/s, which is free for Orange mobile customers (at least 18 months) with a talk plan over GBP 30 (USD 57). Through the broadband connection, subscribers can make VoIP calls. Subscribers can make cheaper calls to Orange mobiles if they subscribe to the 'Anytime' plan. The same FMC service as 'Unik' in France will reportedly be launched by the company in the United Kingdom.[116]

O2 announced that it had plans to offer fixed broadband services in the United Kingdom in addition to its existing mobile services and has acquired Be, a British broadband provider.[117] O2 also decided to take over an independent mobile phone retailer, The Link, in order to have greater control over their retail channels.[118]

In addition to its mobile services, Vodafone provides resale fixed voice services wholesaled by Energis, Viatel's DS.[119] Customers can choose from either fixed telephone or mobile cellular services for voice, combined with either DSL or 3G for broadband.[120] BT, whose Fusion service utilises Vodafone's mobile network, will reportedly also be rolling out enterprise-oriented integrated and converged products as of 2007. C & W also announced its intention to start a FMC service before the end of 2006. To this end, it is in talks with potential mobile service providers.[121]

### Australia

The two largest fixed-line carriers, Telstra and Optus, own and operate mobile infrastructure. Each service is offered on a stand-alone basis or as part of a bundled offering. Mobile operator Vodafone has announced it would be seeking a fixed-line partner to expand its network offerings in the near future.[122]

Apart from service-bundling practices, the Hutchison 'LocalZone' service was provided. This is similar to the 'home-zone' type service. The operator first provides a mobile service, and then makes a local (geographic) number component available. This number provides both originating and terminating call services, and is registered at a fixed address nominated by the subscriber. LocalZone has not been available to new subscribers since 2001, although Hutchison did re-offer the service in late 2005 for a short period.

### Denmark

After conducting a technical trial of UMA technology with Motorola to include WiFi-capable handsets and access points, TeliaSonera decided to adopt Motorola's system and to deploy its commercial UMA FMC solution in Denmark in July 2006.[123]

TeliaSonera then announced that it would launch, the first commercial service called 'Home Free' based on the UMA standard in November 2006. Subscribers will be able to cancel their fixed line subscriptions at home without losing their home phone numbers. TeliaSonera indicated that, in the future, the handset could be used outdoors as an IP phone if the user is in a Wi-Fi hotspot, but it first wants to concentrate on home usage. Just one handset is to be available initially, which is the UMA-compatible Samsung P200 GSM/EDGE phone. Subscribers to the Home Free service will have to pay DKK 499 (USD 85) for the handset, a DKK 199 (USD 34) set-up fee, and either DKK 149 (USD 25) per month for

two people or DKK 189 (USD 32) per month for a family. TeliaSonera is not intending to launch this service in any of its other markets at present, as it first wants to evaluate service take-up and performance in Denmark. It is waiting for vendors to launch more UMA-based handsets as there is still a lack. The service will offer both a normal fixed line number and a mobile phone number which makes it possible to call the user with the fixed line number regardless of the user's location.[124]

## *Finland*

Nokia set up a UMA pilot system in 50 homes in the city of Oulu, Finland, and introduced a new dual-mode handset for a seamless handover of voice and data connections between GSM and Wi-Fi networks. This pilot study is based on the idea that, with UMA, mobile operators can extend their geographical coverage into low-density rural areas without installing costly GSM base stations, relying on hotspots instead.[125] Oulu has over 300 hotspots.[126]

The Finnish operator Saunalahti, which started its business as a MVNO and has acquired a 10% share of the Finnish telecom market, has selected the Nokia system to provide comprehensive solutions for converged networks, allowing it to offer services like VoIP and rich multimedia to both mobile and fixed customers.[127]

## *Hungary*

FMC has been a dominant trend in recent years. It is important to note that operational integration of Magyar Telekom (incumbent operator owned by Deutsche Telekom) is underway, aimed at the convergence of services and organisations in a few years. Joint loyalty schemes, unified billing, and integrated customer care are developing, but only few results of integration are visible on the service level yet. The currently available 'Oda-vissza' tariff is the only special FMC-like offer with unlimited free calls between fixed and mobile Magyar Telekom subscribers.

Vodafone's home-zone offer is another example of currently available FMC service. Vodafone introduced two new tariffs scheme (Otthon Classic, Otthon 2 in 1) in 2006 that aim to make the mobile phone a flexible and attractive alternative for home telephony solutions.

## *Japan*

NTT DoCoMo, a Japanese mobile operator, announced that it would launch a new dual-mode consumer service in 2006 that would let subscribers use their cell phones as wireless LAN handsets at home, which will be charged at the same rates as landline phones.[128] Regarding FMC services for businesses, NTT DoCoMo started 'Passage Duple' in December 2004 which lets office workers use 3G (FOMA) outside and Wi-Fi in the office.[129] NTT Communications, a Japanese long-distance telecommunication operator, has started providing the same kind of service. When used at home or at the office, the terminal is connected to the fixed line telephone network through a local area network (LAN), thereby benefiting from lower charges than those for mobile phones.[130]

Softbank, which owns Japan Telecom's fixed networks and has purchased Vodafone's Japan subsidiary recently, is thought to be planning on providing a FMC service in 2006 in response to NTT DoCoMo's strategy. KDDI, NTT DoCoMo's main competitor, also offers both fixed and mobile voice services and was intending to sell LAN-compatible 'au' mobile phones starting in July 2006 as well as beginning FMC services for businesses.[131]

NTT Solmare, a broadband contents distributor, has been providing a variant of FMC called 'Packet Zero' since April 2005. Packet Zero offers data service in the home by connecting mobile handsets to a fixed broadband network through infrared communications, while it lets subscribers use the mobile network outside.[132]

As a test case, Osaka Gas, a Japanese utility company, deployed 6 000 dual-mode (Wi-Fi and cellular) phones in its offices from May 2005 to March 2006 for all of its full-time workers. Osaka Gas used Meru's WLAN system for VoIP and NTT DoCoMo's dual-mode cellular/Wi-Fi service and handsets. The system was built to handle a maximum of 10 simultaneous calls to each Wi-Fi access point.[133]

Jupiter Telecommunications (J: COM), the Japanese leading cable operator, is testing a service which will allow an existing mobile phone with Wi-Fi support to connect to the household landline (cable) telephone.[134]

### Korea

KT, the Korean incumbent telecommunications operator, has been providing a service called DU: (OnePhone) since 2004 with KTF, KT's mobile subsidiary. Dual-mode handsets connect to KT's fixed PSTN voice network via Bluetooth indoors and to KTF's mobile network outdoors. Handover from indoors to outdoors or vice versa is hand-operated on the handset switch, which is different from BT's handsets which switch over automatically.[135] Those who want to subscribe to DU: also have to subscribe to a fixed voice network. In addition, they use a handset (cordless phone) which is connected to a fixed network in the home, and will therefore be charged for usage based on duration. Users also have to pay the basic mobile voice tariffs to use the mobile network outside, based on call duration.[136] This is because present regulations in Korea do not allow prices of bundled services to differ from the price of each standalone service. As of June 2005, there were 118 000 subscribers to this service.[137]

DU: is the only FMC service available at present, but KT aims to market a cellular/WiBro dual-mode service in late 2006.[138] Originally, WiBro was designed to handle data, and was licensed as such, but the MIC, the regulator in Korea, has recently permitted WiBro to provide voice service as well.[139] Therefore, the cellular/WiBro dual-mode service, which skips the cellular/Wi-Fi dual-mode service, could be a promoter of FMC service in Korea in the near future.

### New Zealand

Telecom New Zealand, the incumbent telecommunications operator in New Zealand, and RoamAD, the supplier of wireless networking software for citywide Wi-Fi networks, have a joint venture which uses RoamAD's platform to roll-out a campus-wide Wi-Fi mesh network at Southland Institute of Technology making it available all students, faculty and visitors to the campus using dual-mode 3G/Wi-Fi mobile phones as well as any Wi-Fi enabled laptops and PDA.[140]

### Norway

Hello AS has been providing a cellular/Wi-Fi dual-mode service called OnePhone since May 2006. It originally started mobile voice service as MVNO in April 2006, but just after its launch Hello started VoWi-Fi and combined it with the cellular service.[141]

**Table Annex 8. OnePhone of Hello AS**

| Operator and service | Monthly tariff | Local fixed call tariff |
|---|---|---|
| Hello OnePhone | NOK 145 (USD 22) | Included in monthly tariff |
| Hello OnePhone light | NOK 27 (USD 4) | NOK 0.59 (USD 0.09)/call + NOK 0.10 (USD 0.02)/minute |

*Note*: Subscription for Hello's mobile services is required.

The above tariff is based on the precondition that if subscribers are within a Wi-Fi zone, the fee for calling is very low or not charged beyond the fixed monthly tariff, and if they are within a cellular network, the ordinary mobile tariff is applied. Within this service the handover function between the Wi-Fi and GSM networks is ensured automatically in such a way that the cheapest way to route the call is chosen. If calling parties are Hello OnePhone subscribers and both are within the Wi-Fi zone, the call is not charged beyond the fixed monthly tariff.

Telenor, the fixed incumbent telecommunications operator, reintegrated its mobile phone subsidiary to prepare for a FMC service.[142] In parallel, Telenor and Nokia have been working together since 2005, and, in March of 2006, they started a FMC trial test. The goal of the trial test is to specify how different IP services can be delivered over multiple access technologies, such as WLAN/DSL, GSM and W-CMDA, to a multi-radio device.[143]

### Portugal

At present, Vodafone, Optimus (group SonaeCom) and TMN (group Portugal Telecom) are the only mobile operators in the market, Vodafone being the only entity not integrated in a group with significant fixed operations in Portugal.[144] Vodafone formerly provided various bundles of services to corporate users, either through PT's fixed network service, or sometimes bypassing PT´s network altogether by linking with a company's communications infrastructure and connecting the service to its own network through Fixed Wireless Access (FWA). In zones where it did not have FWA coverage, it linked a cable or fiber optic connection to its network. It also offered ADSL and ISDN broadband connections to its corporate customers.[145] Vodafone wants to provide converged fixed and mobile services in Portugal.[146] Vodafone launched a voice and data telecommunications home-zone type solution for the residential market in October 2006.[147]

Novis, a fixed line operator and Oprimus, a mobile operator, both SonaeCom subsidiaries, had a partnership to offer a PSTN fixed service which uses GSM cellular technology for the access part of the service (local loop), called Optimus Home.[148] In October 2006, TMN, the mobile PT Telecom's Group subsidiary, launched a home-zone solution.[149]

### Spain

Telefonica and Movistar in Spain provide a service called 'UNO Familiar' which they see as a step towards FMC.[150] UNO Familiar allows one fixed network (Telefonica) subscriber and four mobile subscribers to get a discount for calls made from fixed to mobile, mobile to fixed and fixed to fixed.

**Table Annex 9. UNO Familiar of Telefonica and Movistar**

| Operator | Service | Monthly tariff | Call tariff or other conditions |
|---|---|---|---|
| Telefonica, Movistar | UNO Familiar | EUR 3 (USD 4) | • EUR 0.03 (USD 0.04)/minute + EUR 0.12 (USD 0.15)/call [To the fixed, from fixed to mobile, and from mobile to mobile network]<br>• Up to 60 minutes/month from fixed to mobile network |

*Switzerland*

Sunrise (TDC Switzerland) is providing both a home-zone type service called 'Sunrise myzone' and a dual-mode service called 'Sunrise surf & talk'.

**Table Annex 10. Sunrise myzone (voice) (*1) services**

| Operator and service | Monthly tariff | Local fixed call tariff |
|---|---|---|
| Sunrise relax libero | CHF 6 (USD 5)(*2) | [Within myzone] CHF 0.12 (USD 0.10)/minute [Outside of myzone] CHF 0.59 (USD 0.48)/minute |
| Sunrise relax basic | CHF 21 (USD 17)(*2) | [Within myzone] CHF 0.12 (USD 0.10)/minute [Outside of myzone] CHF 0.49 (USD 0.40)/minute |
| Sunrise relax super | CHF 31 (USD 25)(*2) | [Within myzone] CHF 0.12 (USD 0.10)/minute [Outside of myzone] CHF 0.39 (USD 0.31)/minute |

*Notes*: (*1) SMS service is also available.
(*2) Monthly tariffs are comprised of base tariff and myzone tariff (CHF 6 (USD 5).
(*3) Sunrise myzone service was replaced by sunrise swiss in November 2006.

**Table Annex 11. Sunrise surf & talk service**

| Operator and service | Monthly tariff | Local fixed call tariff | Additional data price |
|---|---|---|---|
| Sunrise surf & talk | CHF 19.90 (USD 16.05)(*) | CHF 0.07 (USD 0.06)/minute (CHF 0.31 (USD 0.25)/minute to Sunrise mobile network) | CHF 0.19 (USD 0.15)/MB |

*Note*: (*) Voice and data services are included. Initial data endowment is 100 MB.

Sunrise surf & talk service lets subscribers use voice and data services, but it is not offered with cellular/Wi-Fi dual-mode handsets. The equipment called 'surf & talk box' embeds the gateway for cellular and Wi-Fi networks, but the Wi-Fi is only for data and the cellular network is for voice. In other words, Wi-Fi is supposed to be used with a PC or PDA, and the cellular network is supposed to be used with the 'surf & talk box', which also plays the role of a telephone handset.

*United States*

T-mobile is launching a cellular/Wi-Fi dual-mode service called T-Mobile Hotspot@Home.[151] At this stage it is available only in 24 stores in the Seattle area.[152] The focus at first is likely to be home users who will be able to make phone calls over the mobile network or make VoIP calls over their own home network through the Wi-Fi router.[153] T-Mobile will therefore not have to rely on the fixed network in the home. Subscribers can continue to use their existing mobile phone numbers.[154] Subscribers can also use this service at T-Mobile Wi-Fi hotspots outside homes; however, other mobile operators are also able to provide high speed mobile networks, and T-Mobile faces strong competition in data-centric contents services.[155] In the United States it is too early to even guess what the FMC market will look like, but it should be noted that all national networks offer data services capable of VoIP, and that wireless VoIP handsets were introduced by the largest VoIP providers in 2005.

*VoWi-Fi*

Another factor playing a crucial role in FMC service provision is VoWi-Fi. VoWi-Fi use Wi-Fi to connect to a VoIP service such as Skype rather than roam between cellular and wireless LAN systems.[156] Most VoWi-Fi operators are small and medium-sized enterprises sourced by venture capital which are at present providing only Wi-Fi based services; however, if these companies decide to enter the cellular market by adopting an MVNO scheme and combining it with VoWi-Fi, FMC can easily be achieved. The following are examples of services provided at present through VoWi-Fi.

**Table Annex 12. Examples of service offers by VoWi-Fi**

| Service | Monthly tariff | Calling tariff |
|---|---|---|
| Skype Zone BETA | EUR 6.50 (USD 8.23) [EUR 2.50 (USD 3.16)/2 hours](*1) | Free |
| Sipgate (Germany) | EUR 8.90 (USD 11.27) (*2) | • Free (Local calls in Germany) • Free (landlines in Austria, Belgium, Denmark, Finland, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Sweden, Switzerland, Spain, United Kingdom) |
| TalkTelecom (Ireland) | N/A (*3) | EUR 2 (USD 3)/hour to Australia or the United States |
| Vonage (U.K.) | GBP 7.99 (USD 15.08) | Unlimited local and national calls in the United Kingdom and Ireland |
| Truphone (U.K.) | Free (need to pay for the use of commercial hot spots. Downloading special software to the mobile handset is free.) | • Free (to other Truphone users) • Free (to 1.6 billion landlines globally: 24 OECD countries) |

*Notes*: (*1) This is a fee for the Wi-Fi usage.

(*2) This is the tariff for Sipgate *Basic mit frat*.

(*3) The service is intended mainly for business customers, therefore a specific price was not indicated.

According to Truphone, the main benefit of UMA is that it works well with GSM operators. However, it is expensive as voice is carried over the operators' GSM networks rather than the Internet. Truphone offers mobile calls which are either free or at a cost lower than through a conventional fixed line, by using SIP.[157]

## GLOSSARY

| | |
|---|---|
| 3G | Third-generation Mobile Network |
| 3GPP | Third Generation Partnership Project |
| ADSL | Asymmetric Digital Subscriber Line |
| ARPU | Average Revenue Per User |
| CDMA | Code Division Multiple Access |
| CTP | Cordless Telephone Profile |
| DECT | Digital Enhanced Cordless Telecommunications |
| DSL | Digital Subscriber Line |
| EDGE | Enhanced Data Rates for GSM Evolution |
| ETSI | European Telecommunications Standards Institute |
| EV-DO | Evolution Data Only (Optimized) |
| FDD | Frequency Division Duplex |
| FMC | Fixed-Mobile Convergence |
| FMCA | Fixed-Mobile Convergence Alliance |
| FTTH | Fiber to the Home |
| FWA | Fixed Wireless Access |
| GPRS | General Packet Radio Service |
| GSM | Global System for Mobile Communication |
| HSDPA | High-Speed Downlink Packet Access |
| HSPA | High-Speed Packet Access |
| HSUPA | High-Speed Uplink Packet Access |
| IEEE | Institute of Electrical and Electronics Engineers |
| IETF | Internet Engineering Task Force |
| ILECs | Incumbent Local Exchange Carriers |
| IMS | IP Multimedia Subsystem |
| ISDN | Integrated Services Digital Network |
| ISP | Internet Service Provider |
| LAN | Local Area Network |
| LLU | Local Loop Unbundling |
| MMS | Multimedia Messaging Service |
| MNO | Mobile Network Operator |
| MVNO | Mobile Virtual Network Operator |
| NGN | Next-Generation Network |
| OFDM | Orthogonal Frequency Division Multiplexing |
| OFDMA | Orthogonal Frequency Division Multiple Access |
| PDA | Personal Digital Assistant |
| PHS | Personal Handy Phone System |
| PSTN | Public Switched Telephone Network |
| SIM | Subscriber Identity Module |

| | |
|---|---|
| SIP | Session Initiation Protocol |
| SMS | Short Message Service |
| TDD | Time Division Duplex |
| TISPAN | Telecoms & Internet converged Services & Protocols for Advanced Networks |
| UMA | Unlicensed Mobile Access |
| UMTS | Universal Mobile Telecommunications System |
| USO | Universal Service Obligations |
| VOB | Voice over Broadband |
| VoIP | Voice over Internet Protocol |
| W-CDMA | Wideband Code Division Multiple Access |
| WiBro | Wireless Broadband |
| WiMAX | Worldwide Interoperability for Microwave Access |
| Wireless LAN (WLAN) | Wireless Local Area Network |

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