

FIXED-MOBILE CONVERGENCE

Marko Jagodič

RASKOM d.o.o., Ljubljana

Key words: fixed communications, mobile communications, device convergence, service convergence, network convergence, trends, long term perspectives

Abstract: Fixed-mobile convergence (FMC) is a phenomenon which is dominating at present the development of fixed as well as mobile communications around the world. The article tries to clarify the background for different understanding of FMC and the main reasons which started it and influenced its evolution. The article also addresses some of the more important FMC supporting technologies like Unlicensed Mobile Access (UMA), IP Multimedia Subsystem (IMS) and Femtocells, describes and discusses the most important development phases of FMC as well as the rationale for investing in it.

Fiksno-mobilna konvergenca

Ključne besede: fiksne komunikacije, mobilne komunikacije, konvergenca naprav, konvergenca storitev, konvergenca omrežij, razvojne smeri, dolgoročna perspektiva

Izveček: Fiksno-mobilna konvergenca (FMC) je pojav, ki trenutno obvladuje razvoj tako fiksnih kot tudi mobilnih komunikacij po svetu. Članek poizkuša najprej pojasniti ozadja za različno razumevanje FMC in glavne razloge, ki so sprožili njen začetek in vplivali na njen razvoj. Članek tudi predstavi nekatere za razvoj FMC najbolj pomembne tehnologije, kot so Unlicensed Mobile Access (UMA), IP Multimedia Subsystem (IMS) and femtocelice, predstavi in komentira najbolj pomembne razvojne faze FMC in razloge za njeno uvajanje.

1. Introduction

Fixed-Mobile Convergence (FMC) is a process which started when mobile communications, based primarily on voice services, reached a worldwide maturity and mobile customers began to look for new more complex services involving voice, data, and video. One of the most important technologies behind, which persistently expands the availability of these new services to fast growing number of mobile users, is microelectronics, the domain in which Prof. Lojze Trontelj excelled producing innovative products of worldwide importance.

The article will try first to explain the different perceptions of FMC by different players in the area of electronic communications. The description of current evolution towards FMC will follow complemented by some important technological aspects as well as development phases of FMC. The rationale for introducing FMC will be addressed at the end of the article.

2. What is Fixed – Mobile Convergence?

Mr. Ilkka Nakaniemi from Nokia Siemens Networks made an excellent summary of FMC at OECD Forum in October 2006 / 1 / saying that FMC is rather complex process which does not involve only service and application convergence. Device and network convergence are equally if not more important and all of them are leading to industry convergence as shown in Fig. 1

Different people understand FMC quite differently. For an operator such as Iceland Telecom, a hosted PBX Centrex service focused on SMEs understands FMC as a combi-

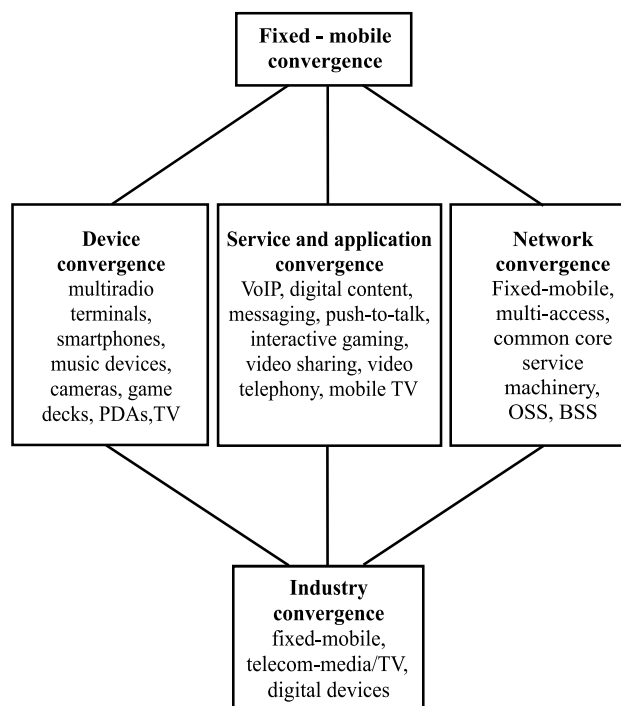


Fig. 1 Fixed – Mobile Convergence elements

nation of PSTN, ISDN and GSM to provide an identical set of services for mobile and fixed workers. An operator like BT views FMC as a new and over-reaching integrated wireline/wireless business opportunity, with variations to serve both consumer and corporate customers. Ryan Jarvis, BT chief of convergence products, describes the FMC phenomenon as three dimensional: "One stratum is network convergence which enables devices to move between networks. Then you have service convergence where you

have one bill and one customer contact centre that supports that device across multiple networks. And then you have commercial convergence which is usually called bundling – it’s effectively one product”.

FMC enables really rich set of services using the same device – mobile phone. Users expect and want to have access to all available services on device they have with them at the time (mobile phone, laptop or others) regardless of the operator the device is connected to, fixed or mobile, the one they are subscribed to or another, native or foreign.

3. The evolution towards FMC

The Organisation for Economic Co-operation and Development (OECD) has come up with the following findings related to the evolution of FMC /2/:

- Dual-mode cellular/Wi-Fi handsets exist using Wi-Fi modems in the home environment to access VoIP through ADSL connections
- 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 utilize 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.

Obviously there are many ways being used to provide FMC services some of which are more technologically integrat-

ed than others. FMC services are definitely representing a significant challenge to all telecommunication operators. Bundling of disparate services over separate networks is considered as a marketing step necessary to support customers.

From the viewpoint of services, the fixed network operators are endangered by the penetration of mobile services into their market, while the mobile operators are faced with the saturation of mobile markets based on the second generation equipment and the need to persuade customers to shift to third generation equipment. At the same time, at least in some countries, more and more fixed network operators which traditionally did not provide mobile services are entering into mobile markets through MVNO-s (Mobile Virtual Network Operators). Nevertheless both mobile and fixed telecommunications operators have to compete with IP based services using fixed or Wi-Fi networks and therefore they are forced to invest either into the development of Next Generation Networks (NGN) or into support systems like the IP Multimedia Subsystem (IMS).

Cable operators are also beginning to offer FMC services and are keen to provide multiple play services such as triple play or quadruple play and are becoming direct competitors to PSTN operators. It is expected that this direct competition will increase in the future.

The FMC service called home-zone service is known for more then 10 years already. Here, mobile operators offer through their mobile network a virtual fixed line area called the home-zone (for example: UnoFon service by Sonofon in Denmark from 1997 on). Strictly speaking, this type of service is better described as fixed-to-mobile substitution leading to an increase in the amount of mobile call volumes with respect to all voice volumes.

For better understanding of evolution towards FMC it is very illustrative to take a look at the role Wi-Fi hotspots are playing in promoting FMC. The availability of such hotspots is quite impressive as it can be seen from Table 1.

Wi-Fi hot spots are promoting FMC through VoIP-enabled wireless telephony (VoWi-Fi) by utilizing devices that use

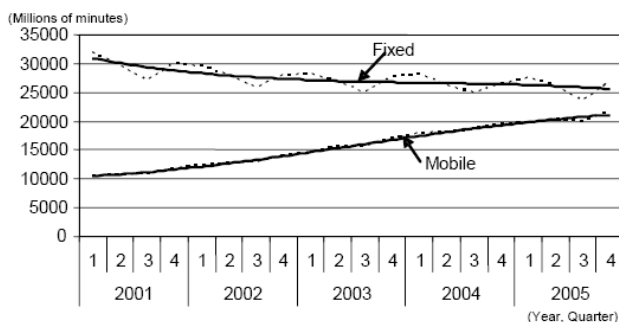
Table 1 Number of Wi-Fi hotspots (as of 11.09.2006)

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>).

Wi-Fi to connect to a VoIP service such as Skype rather than roam between cellular and wireless LAN systems. 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. Mobile telecommunications operators are also challenged by Wi-Fi hotspot operators allied with Skype. Therefore some mobile operators seriously consider connecting their cellular networks with Wi-Fi hotspots. Namely the availability of Wi-Fi hotspots is also continuously growing. For example, in the United Kingdom, the number of Wi-Fi hotspots almost doubled between June 2005 and June 2006. On top of Wi-Fi new wireless technologies are coming such as mobile WiMAX which will definitely influence the delivery of FMC services.

The high penetration of mobile phones in OECD countries has resulted in significant substitution of fixed network traffic with mobile network traffic. For example, in France, the volume of voice calls through fixed networks has decreased while voice calls through mobile networks have increased as indicated in Fig. 2

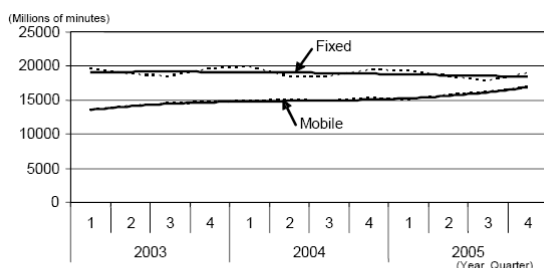


Note: Bold lines are trend lines (3rd order).

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

Fig. 2 Volume of voice calls in France

In the United Kingdom the substitution was not as extensive as in France. One study indicates that the majority of those examined in the United Kingdom (65%) were not so much in favor to abandon their fixed line services as in other European countries surveyed.



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)).

Fig. 3 Volume of voice calls in United Kingdom

To get the right indication of the future trends of FMC services it is necessary to watch the changes in these trends in individual countries. One important variable influencing future trend could be the number of mobile-only households. At present the percentage of households that only use mobile phones within the EU25 countries is 18 %. Another important variable is the ratio of mobile call volumes to all voice volumes. This ratio is close to 70% in Finland, over 50% in Austria, more than 40% in France and around 30% in the United Kingdom. In Germany this it is only 12% which means an opportunity for German mobile operators to take a market share from fixed network operators, especially through the provision of home-zone type services. It should be also noted that in the process of transition to NGN or IMS, FMC does not relate to voice calls only but covers a much broader 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. Telekom Slovenia has decided to follow this course.

4. Technological aspects

UMA (Unlicensed Mobile Access)

This technology enables access to GSM and GPRS mobile services over unlicensed spectrum using Bluetooth and WLAN 802.11. Subscribers are able to roam and handover between cellular networks and public and private unlicensed wireless networks using dual-mode mobile handsets. The advantage of UMA is its ability to provide FMC capabilities based on existing wireless networks. How UMA works?

IMS

IMS, proposed by 3GPP (3rd Generation Partnership Project), was originally intended to provide IP-based communications over mobile network /3/. Later on it developed into the leading standard for the NGN because it can also be used with fixed IP-based networks. It is based on using SIP protocol. Some operators are still hesitant to decide for IMS mainly because of the still high initial investment cost. However, advanced standards, improved capabilities, and decreasing cost of introducing IMS will convince more and more operators to accept IMS. Namely IMS provides a better method for charging multimedia sessions, because the identity management (IM) is an integral part of the core IMS technology structure and IMS can be used by all kind of operators, fixed, mobile, and integrated operators. It helps to ensure a level playing field among operators and service providers at the technological level. The main reasons to invest in IMS are:

- for mobile operators: deployment of novel services to increase usage

- for fixed operators: reduction of CAPEX and OPEX and capability to offer competitive services
- for integrated operators: achieving service continuity across different domains

Femtocells

A femtocell is a small cellular base station designed to be located inside a home and using a DSL/Cable connection to the backhaul traffic. UMA-enabled cellular/Wi-Fi dual-mode handsets require Wi-Fi access points. This kind of access could be very expensive especially with picocells. Femtocells 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 even for 2.5G, can have air interface with existing handsets. Using a single handset improves customer loyalty and reduces churn. In addition, the backhaul traffic from femtocell stations to a mobile core network will run through fixed broadband, thus giving fixed operators a motivation to be involved in this kind of access especially with FTTH as dominating fixed network access technology.

Development phases of FMC

- Service bundling
- FMC using broadband /Wi-Fi connections (cellular/Wi-Fi dual-mode service)
- Mobile based 'dual-mode' services
- Network convergence

Service bundling

At the very beginning of FMC operators were offering bundling of fixed and mobile services without any technological interface between the two types of networks /2/. While bundling provides subscribers with price discount the use of new technologies brings very little added value for them. Cellular voice and data services can be bundled too, although for data services the use of laptops is generally preferred. Usually without an interface between cellular and Wi-Fi networks 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. There are also services which link both fixed and mobile networks but are not technically converged like services offering a single voice mailbox over both fixed and mobile networks.

Many 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.

FMC using broadband /Wi-Fi connections (cellular/Wi-Fi dual-mode service)

There are several variants of this kind of FMC services /2/:

- Dual-mode services using a mobile handset and Wi-Fi modems in the home environment to access VoIP

through ADSL connections (for example "Unik" in France). These are examples of incumbents "cannibalizing" their PSTN traffic. New entrants use the same technology but rely on local loop unbundling (LLU) like "Home Free" in Denmark.

- Services through cellular/Wi-Fi dual-mode handsets that do not have a handover function from one mode to another, offering each mode separately (for example "surf & talk" in Switzerland).
- Cellular/Wi-Fi dual mode voice service which has a handover function from one mode to another, but it does not utilize a fixed voice or broadband network in the home (for example "Hotspot@Home" in USA)

When subscribers are within the Wi-Fi zone, the calling fee is very low or free, and when they are 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.

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 must compete with the fixed line operators encroaching through FMC into the market which was traditionally reserved for mobile operators. 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 Mobile Virtual Network Operators.

Network Convergence

For the really consequential and sustainable long term network convergence, which is the enabling basis for the fixed-mobile convergence of services and devices, it is not enough to focus only on adopting the principle of all IP networks. This is good enough for the immediate and short term actions in the direction of FMC. For a successful long term FMC much more is needed. With the global acceptance of FMC as the most appropriate mode of electronic communications in the future the existing networks themselves have to be reassessed from the point of view of suitability of their structures to confront with: the exponential growth of traffic, the required geographical coverage, and the need to set up a simple system to support inter-working of the fixed and mobile domains as well as operators.

Photonic technology in the access area has been gaining momentum all the time, driven by the continuous growth of bandwidth, essential for the successful introduction of new services and applications. The most fundamental challenge at this point of evolution of optical networking is to achieve convergence at multiple levels, among them optical - wire-

less being very important to be able to build an integrated optical platform for an efficient end-to-end service delivery with guaranteed performance. It is expected that the total amount of end users and end devices needing broadband connections in the near future will rise to the order of trillions. Therefore a considerable enhancements in the access part of the network are needed including the convergence of optical and wireless technology leading to a hybrid optical – wireless access infrastructure that will facilitate user mobility and support the vast number of connected devices and sensors, while the simultaneous introduction of WDM will help to increase bandwidth and to enhance ability to upgrade networks /6/.

5. The rationale for FMC

The rationale to invest into FMC depends very much on the type of operator /4/, /5/. The fixed network operators see in FMC the opportunity to generate new revenue through quick response to fixed and mobile customers by developing themselves into one-stop-shops for their needs. At the same time FMC is also the best tool to defend them efficiently against mobile substitution.

The mobile network operators have different rationale to invest in FMC. They are faced with market saturation in second generation mobile markets and declining average revenue per user in their existing markets. They are also faced with competition from voice calls made over the Internet and over Wi-Fi or Mobile WiMAX networks. FMC helps them by facilitating the number portability and by reducing the price of mobile calling and access to data using mobile terminals through the provision of cellular/Wi-Fi dual-mode services.

On the other side shifting to an all IP-based network architecture FMC works well simultaneously for both fixed and mobile network operators by reduction of longer-term maintenance costs and allowing the provision of higher value-added services through service bundling. It is expected that the next generation network technology will bring substantial cost reductions which will certainly increase the profitability of most operators.

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*Prof. Dr. Marko Jagodič, univ.dipl.ing.
RASKOM d.o.o.
Omersova 62, SI-1000 Ljubljana, Slovenia
E-mail: jagodic.marko@guest.arnes.si*

Prispelo (Arrived): 08.05.2008 Sprejeto (Accepted): 15.09.2008