Mobile Solution for FMC

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Competition in the business environment of cellular carriers is expected to become much more intense when mobile-number portability is introduced, new carriers enter the market, and various other developments unfold. A Fixed-Mobile Convergence (FMC) service has already been launched in South Korea and the United Kingdom. In Japan, an FMC service targeted for the enterprise market has been launched with the introduction of a hybrid mobile terminal that uses the capabilities of 3G cellular phones and wireless LAN IP phones. In this paper, we consider the significance of FMC for carriers from the market point of view. We also introduce the functional architecture of FMC and describe further issues that must be studied to realize FMC.

1. Introduction

Fixed-Mobile Convergence (FMC) means the convergence of mobile-phone and fixed-line networks. Its convenience will be very appealing to users, and it is expected to become a leading force in the future of communications services around the world.

KT in South Korea launched its DU service in October 2004, and BT in the United Kingdom started its BT Fusion service in June 2005. Also, FMC services for enterprises have started in Japan with the appearance of a hybrid terminal consisting of a mobile phone with IP telephony capabilities.

This paper describes the architectures, functional model, and the future tasks for the full realization of FMC. It also examines the market trends and users' needs for FMC and the significance of these for carriers.

2. FMC-related market trends

This section describes the FMC-related market trends and the requirements for FMC.

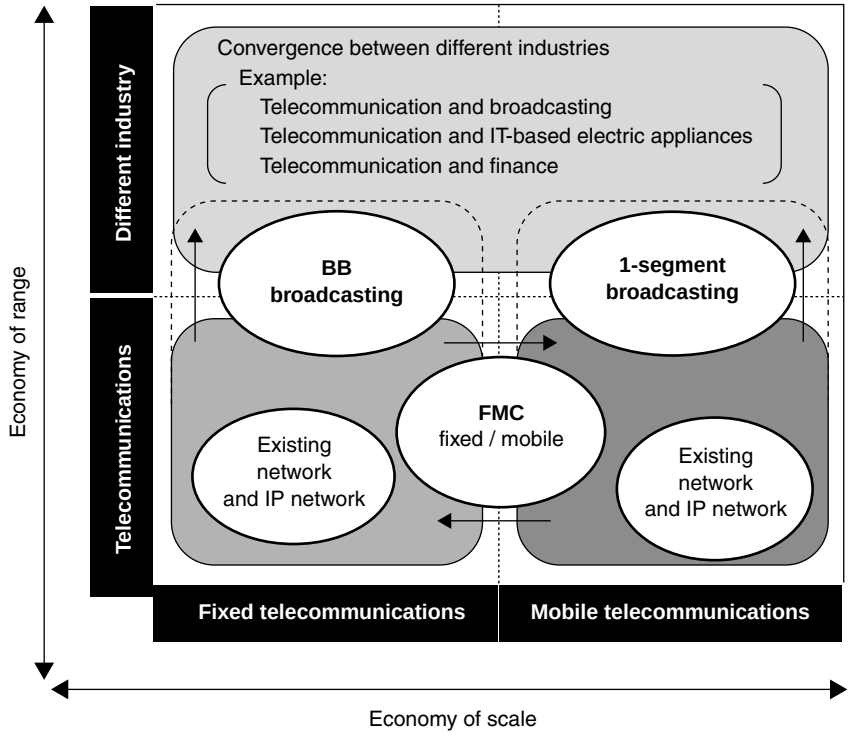
2.1 Movement towards FMC

Due to saturation in the telecom market, the emergence of new carriers will greatly increase the competition in communication services and the creation of a new market with various convergences will play an important role in the growth of future drivers (**Figure 1**). Some examples of these convergences are as follows: fixed/mobile, communication/broadcast, communication/information appliance, and existing net/IP net convergences.

Some of the expected advantages of FMC are that it will attract a large base of users, integrate various services, and improve convenience through ubiquity.

It could be said that the three-way diverse-concept and the movement consisting of carriers, government, and users are becoming converged by FMC. For example, the government has reorganized the radio-frequency bands and eased the regulations for entry into the cell-phone market and is steadily promoting the construction of the ubiquitous society known as "u-Japan."

Although the users' needs are becoming increasingly diversified, users demand low-cost



BB: Broadband

Figure 1
Ideas for various convergences.

broadband services and their expenditures are shifting from fixed to mobile telecom and from telecom to content services.

2.2 What is FMC?

FMC can be simply defined as "one phone, one number, one bill." With FMC, both voice and information services are seamlessly available across fixed and mobile networks.

In other words, FMC is a service in which the most appropriate network can be used according to the situation without users being aware of when the terminal switches between fixed and mobile modes. FMC also enables automatic network selection for incoming and outgoing calls, roaming and handover between different networks, and an integrated billing service (**Figure 2**).

The users' needs for FMC are based on low-cost and improved convenience; however, to expand the market, a service in which users can recognize the new value and benefits of converging fixed and mobile networks is needed.

FMC is expected to provide a ubiquitous service that can be used at any time and any place. It is also expected to lower costs by bundling multiple services and simplifying services through the "one phone, one number, one bill" feature.

In the enterprise market, FMC is expected to create new business opportunities by making business operations more efficient, presenting business-model innovations, and reducing costs. As a result, more efforts toward greater convergence, for example, the integration of voice, data, and business applications, are expected.

Moreover, as users' needs become more diversified, and competition to secure registered user has increased by the introduction of the Mobile Number Portability (MNP) system and the emergence of new carriers in the market, it becomes more important that FMC services are promoted and prepared (to secure registered user).

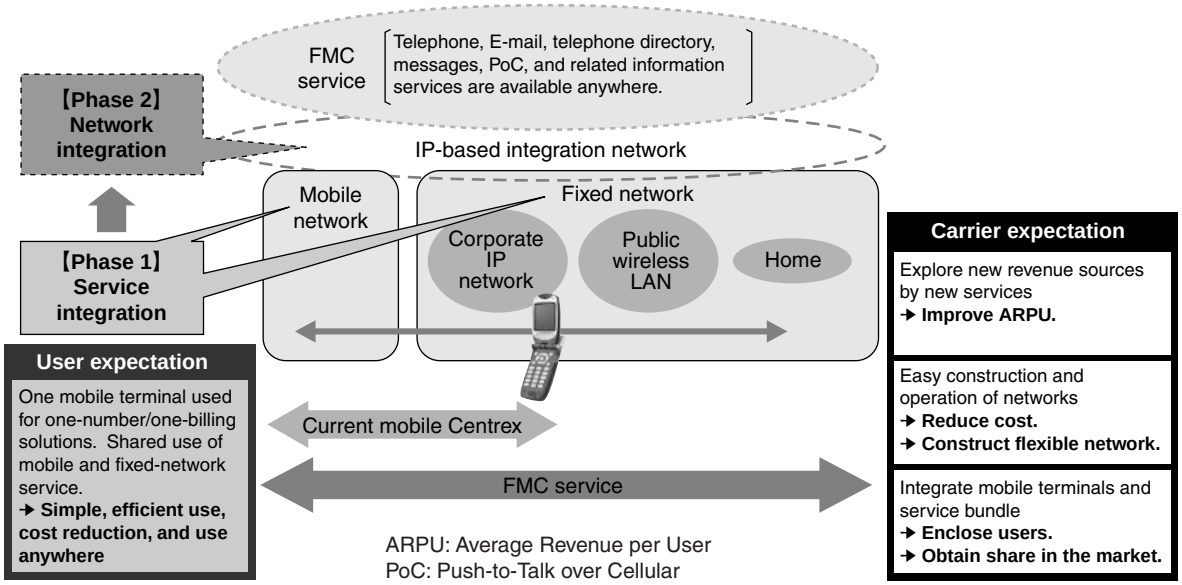


Figure 2
Concept of FMC service.

FMC services will have a strong appeal to users because they will enable internal and external accesses and provide low-cost communication using VoIP and discounts though bundling.

3. Requirements for FMC services

FMC enables users to access the optimum networks at any location without being aware of whether they are using a fixed or mobile network. For example, it enables users to access a fixed ADSL/optical network at home and use the same terminal to access a 3G mobile network outside the home. The requirements of this service are described below (**Figure 3**).

1) The user must be provided with the same Quality of Service (QoS) at all times and at all locations.

Callers and called parties must be given the same basic originating and terminating call services and supplementary services without needing to be aware of their location.

2) Users must be provided with the optimum service for their situation.

Whether access is done via an ADSL/optical network or a 3G mobile network, the access network must be selected according to the users' location and users must be given high-quality services by exploiting the characteristics of each access network.

Users should receive the optimum service according to their situation. For example, there should be a wide service area and high mobility when using a mobile network and low-cost and high-speed communication when using a fixed network.

3) Service must be secure and reliable

For FMC services to be regarded as enhancements of existing landline and cell-phone services, they must be reliable enough to handle lifeline and emergency response services. Also, they must provide strong security measures (i.e., against interception) and provide speech quality and operational stability at the same levels as in existing services.

4) An extensive variety of services must be available

To expand the market by integrating fixed and mobile networks, it is necessary to demonstrate the new value and cost benefits of FMC

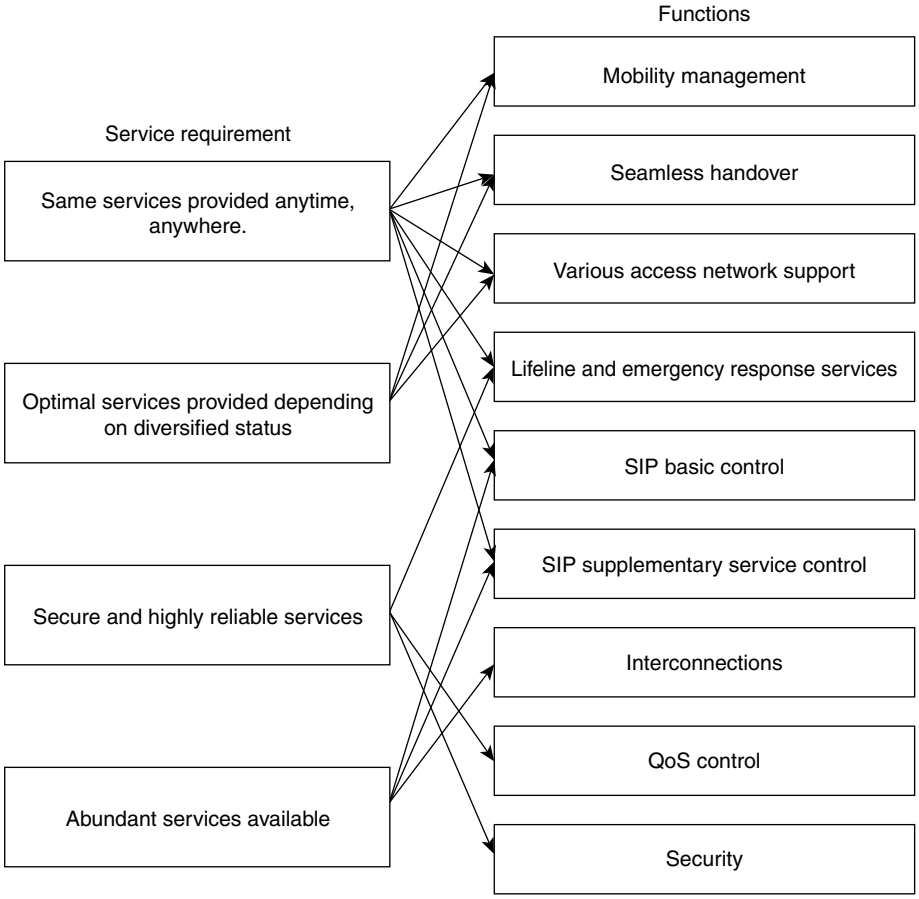


Figure 3
Mapping between service requirements and functional building blocks.

services in a way that will attract users.

The services will include not only the existing services of landlines and cell phones, but also the call transfer functions and the integration of voice, data, and business applications that use the presence functions available in IP Centrex. Therefore, a network infrastructure to which a variety of services can be added will be needed.

4. Features required for FMC service

The following are the major functions necessary to realize an FMC service (Figure 3).

1) Mobility management

To provide an anytime/anywhere FMC service, it is necessary to continuously track the user's whereabouts and deliver incoming data based on this location information.

While the existing mobile communication system manages the user mobility within an access network, FMC needs to control various access networks such as WLANs and 3G cellular-phone networks and select the most appropriate route.

2) Seamless handover

A function that enables users to seamlessly shift within and across access networks is required. For example, FMC services must be handed over from a 3G cellular-phone network to an ADSL/optical fiber network.

3) Features to support various access networks

A feature that allows any type of access network to be selected according to its availability and a feature for converting the access network dependent communication protocols to the access network independent communication protocol of

the core network (i.e., SIP) are needed.

4) Lifeline and emergency response services

Functions for complying with lifeline requirements, for example, support for emergency responses and ensuring system reliability are needed.

5) SIP basic control

A session control function, for example, for basic call origination/termination and routing, is required to continue the existing call services. The SIP protocol, which is widely used in IP networking, is the best choice for the session control protocol.

6) SIP supplementary service control

A supplementary service scenario and network resources (talkie files, CODECs, etc.) for achieving supplementary services are required so a wide variety of services can be provided.

7) Interconnection function

Interconnection with other carriers is essential for expanding the use of FMC services. To achieve it, functions such as a protocol conversion function and account adjustment function are required.

8) QoS control

To provide a wide variety of services over the IP network, a function for ensuring the quality of communications according to the service characteristics is required. A QoS control function is especially important to ensure a sound quality equal to that of existing phone services, regardless of IP traffic levels.

9) Security

A high level of security and the protection of privacy are necessities for the communication services of carriers. In particular, to avoid interception, there should be a focus on features for authorization and confidentiality.

5. Architecture of FMC network

FMC services are achieved by combining various technologies. To cope flexibly with the development of future services, each function needs to be hierarchically integrated into the application, session control, transport, and access layers. The ideal architecture for achieving this is one that enables each function to be independently and hierarchically enhanced.

The functions of the layers of an FMC network are described below (**Figure 4**).

1) Application layer

The application layer provides supplementary SIP services and adds additional value to network services. This layer allows high modularity as well as low cost and rapid development and introduction because it is separated from the lower session control layer.

2) Session control layer

The session control layer executes session control functions such as those for basic call origination and termination. For example, it executes the location control function, basic call control function (i.e., routing), and carrier interconnection.

Session control requires a standard framework (arrangement of the signal system, accounting, and security policy) for carrier interconnection.

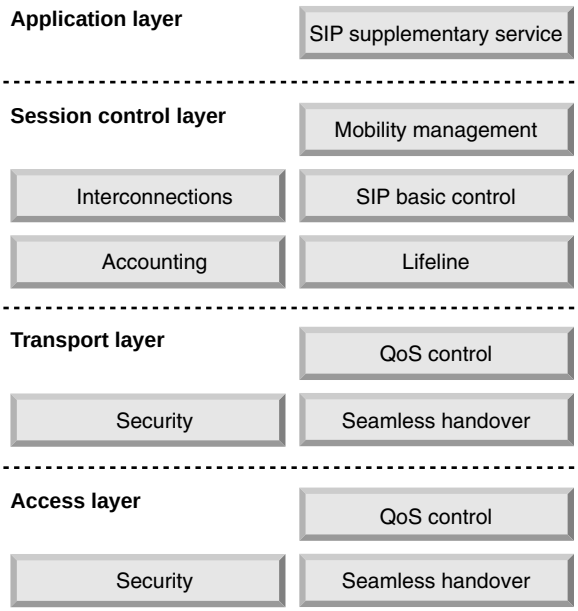
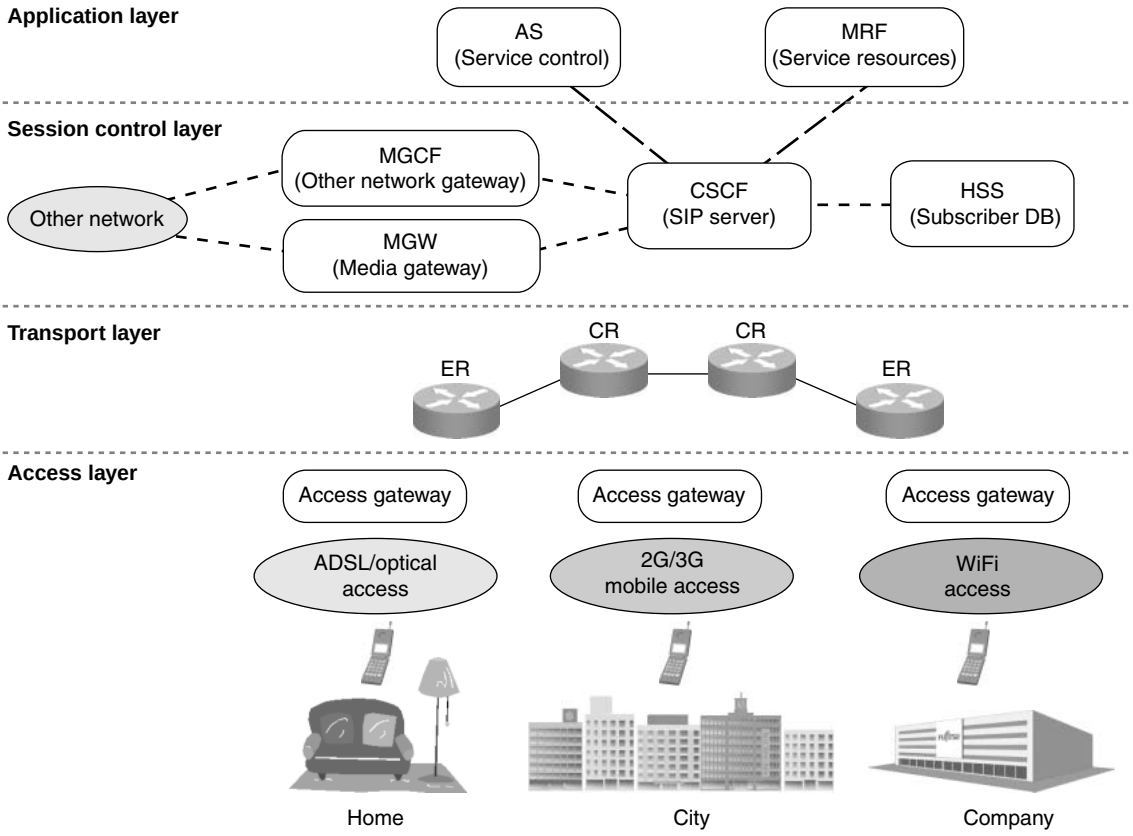


Figure 4
Functions of individual layers of FMC network.



AS: Application Server
CSCF: Call Session Control Function
MRF: Media Resource Function
HSS: Home Subscriber Server
MGCF: Media Gateway Control Function
MGW: Media GateWay
CR: Core Router
ER: Edge Router

Figure 5
FMC mobile solutions.

In the 3rd Generation Partnership Project (3GPP), IP Multimedia Subsystem (IMS) has been established as the standard framework of the IP multimedia system.

Also, IMS has been actively standardized, with a focus on FMC, and is attracting the attention of many carriers and vendors.

3) Transport layer

The transport layer transports the signaling of session control and provides functions for IP-based transport.

For example, this layer provides IP base mobility, QoS control, and a security function by means of Virtual Private Networks (VPNs) as well as the basic transport function.

4) Access layer

The access layer enables access between users and networks by wireless or fixed transmission systems. Various options for FMC access are possible depending on the usage conditions, for example, cost, usage area, transmission band, mobility, and power consumption.

Due to the rapid growth and innovation of wireless access technology, it is important to ensure modularity and expand the range of options.

To achieve these goals, it is necessary to place the access gateway between the core network and the access network and absorb the protocol differences between the access networks (**Figure 5**).

6. Technological requirements of FMC services

The technological requirements for providing a carrier-grade FMC service include the following:

1) Seamless handover

The standard rules for handovers between IP networks and non-IP networks are currently under discussion, and an examination of the handover method will be needed in the future.

2) Lifeline and emergency call services

Basic call control and supplementary service control will be done using SIP protocol. However, the emergency call guidelines of the Ministry of Internal Affairs and Communications (MIC) of Japan are currently undetermined.

Technology will need to be developed to comply with the guidelines, for example, technology for tracking the location of terminals and for performing callback from emergency centers and priority control.

3) QoS assurance by wireless access

QoS assurance by wireless access networks such as WLANs is still technologically unestablished. Although the 802.11e includes specifications for WLANs, it has not been thoroughly established how this can be applied to call services.

4) Ensuring security in IP transport

Methods for establishing a system in which privacy capability and authorized interception capability can coexist via encryption technology should be investigated.

7. Conclusion

This paper discussed FMC services, which are expected to take a leading role in the future of communication services, and considered the significance for carriers in these services from the viewpoints of market trends and users' needs.

It also described the requirements, architectures, and future tasks for achieving FMC services.

Fujitsu is making strong efforts to provide a service in which users can recognize new value from the convergence of fixed and mobile networks and the merging of business applications for enterprise users. We will work towards further convergence and focus on the development of mobile solutions to establish FMC in a way that will attract end users and carriers.

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