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Fixed-Mobile Convergence – A Technical Reality Check

LEILA LAMTI-BEN YACOUB **The world is moving unstoppably towards a seamless voice, data and multimedia environment. Fix-Mobile Convergence (FMC) is clearly an opportunity for fix only operators to defend against mobile substitution.**

For integrated operators such as Swisscom, FMC does not only allow cost savings on the long term, but enables the creation of value propositions centred around the continuity of service experience. Users will be able to have voice, messaging and content uninterrupted by limitations of one access technology. This article analyses the technical challenges that need to be dealt with in combining and seamlessly integrating fix and mobile access and core networks.

Introduction

Fixed-mobile convergence (FMC) – the integration of wireline, wireless and cellular technologies with services to create a single telecommunications network foundation – promises to obliterate some of the physical barriers that now prevent telecom service providers from reaching all of their potential customers with all types of services. This trend is strongly pushed by the ever-increasing availability of new wireless network technologies. Indeed, vendors are continuing to push technologies like Wifi, which enables wireless broadband access in geographically limited zones, and WiMAX (802.16E), which is set to provide a similar capability over a much wider area while giving users significantly more "mobility" than Wifi.

For an integrated operator such as Swisscom, FMC is viewed as a means to seamlessly combine fix and mobile offerings into a single common value proposition for end-customers: Services are delivered independent of access and delivery channels while taking into account terminal capabilities and user profiles contexts. In order to ensure the end user a continuity of experience, a total integration of the different access and core networks from the fix and mobile sides needs to be achieved. So, what does this really mean in terms of technological implementations? How could an integrated backbone look like in the coming years?

This article is organised as follows: First, the different options for integrating access technologies are presented and a convergence roadmap is proposed, with a special focus on telephony services. Then, a convergent implementation of a unique control plane in the core network based on the IP Multimedia Subsystem (IMS) architecture is proposed. Finally the article is summarised and an outlook for future activities proposed.

Integration Options of Access Networks

When an end device connects through either a wireless or a wireline (fix) access network, its traffic is always routed to a Packet Switching (PS) core network based on the IP technology. However, an end device which uses a cellular access network (i.e. GSM, GPRS or 3G) sees its voice traffic routed to a Circuit Switching (CS) core network based on GSM, and its data traffic routed to a Packet Switching (PS) core based on IP (fig. 1).

The challenge is to integrate existing and future access technologies so that such diversity in access types is hidden and that the continuity of experience is ensured, be it for voice or data services.

First Convergence Step

The first clear and obvious step towards a convergent implementation is to integrate both PS core networks of the fix and mobile sides (fig. 1). Such a convergence is completely transparent for the end user but allows a CAPEX and OPEX optimisation of the incumbent's infrastructure costs.

Second Convergence Step

The second step consists of preparing access and core networks for the implementation of IP-based multimedia services while ensuring the continuity of experience. Obviously, the highest challenge is dealing with real-time services, specifically voice, to allow handover between different access networks as the end user moves from one access network to another.

On the fix side, it is clear that voice traffic will be migrated in the next coming years from CS core network (PSTN and ISDN) to PS core network based on Voice over IP (VoIP), hence phasing-out the CS core network. This trend is also strongly supported by the competitive landscape which pushes classical operators such as incumbents to deploy the widespread peer-to-peer Session Initiation Protocol (SIP) based services. However, on the mobile side, part of the voice traffic could be migrated to VoIP only for end devices using the wireless access networks (WiFi and WiMax). On the cellular access side, voice will remain CS based (GSM) for a longer period of time simply because the combination of cellular access with PS core has been designed only for data services (non real-time services). Basically, implementing VoIP over GPRS or UMTS with the current technology is far from being an optimal solution in terms of throughput efficiency and Quality of Service (QoS) parameters.

Ensuring continuity of experience for the voice service while keeping two separate core networks using different technology paradigms (CS versus PS) requires some inte-

gration effort. Depending on the integration level, we mainly distinguish two scenarios:
- Scenario 1: Integration on the access level
- Scenario 2: Integration of backbone level

Scenario 1: Integration on the Access Level
In this scenario, the mobility management mechanisms of the cellular network are emulated by a new network element needed for both wireline and wireless access networks. Such equipment mimics the behaviour of a classical mobile Base Station Controller (BSC). In this implementation, the end user initiates on his dual-stack WiFi/GSM phone a VoIP phone call at home using SIP over WLAN. The traffic is sent on the DSL access network to the PS core network to reach the SIP server. Such SIP server is also connected to the BSC emulation box to ensure mobility management. Once the end user leaves home, the WLAN signal is detected so low that a handover request is sent by the end device to the BSC emulation box. This element is responsible for contacting the closest BSC to which the GSM stack is connected and to forwarding the ongoing call to the GSM network (fig. 2).

The main advantage of this scenario is the seamless handover enabled by the emulation of a cellular access on the wireline and wireless accesses. Its main drawback is clearly the cost of investment since a high number of new equipments need to be added very close to the end user. The major players in this area are Unlicensed Mobile Access (UMA) Consortium members such as Kineto and Motorola.

Scenario 2: Integration on the Backbone Level
This scenario is quite identical to the previous one except that the emulation box is placed on the Mobile Station Controller (MSC) level. Since a number of BSCs are served by an MSC, a clear advantage of this scenario is the reduced cost of investment in comparison with scenario 1. However, the handover delay is clearly higher than in scenario 1, which makes the seamless experience doubtful. Such a solution has not yet been tested in the lab, but could be a good compromise between the cost of investment and the attained level of seamlessness of the handover. The major players in this area are small start-ups such as Bridgeport, PhoneDo, etc.

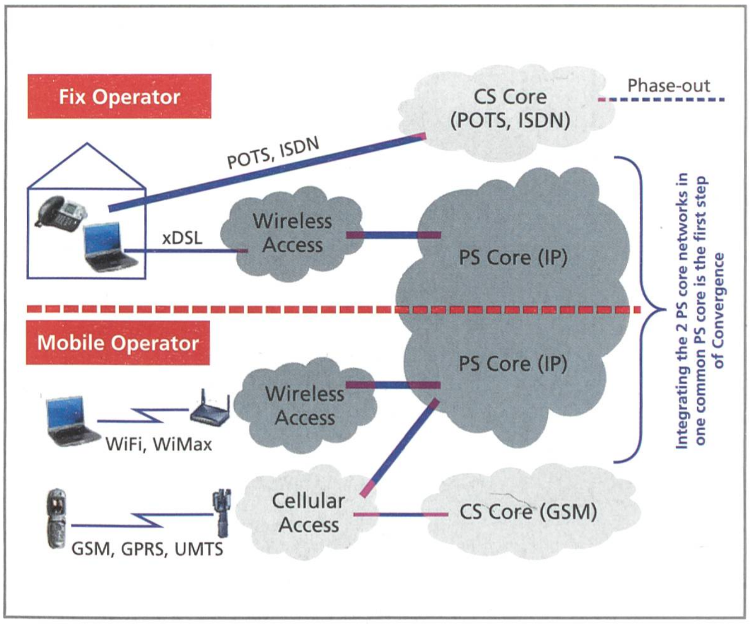

Fig. 1. Existing access and core networks in a typical incumbent's infrastructure.

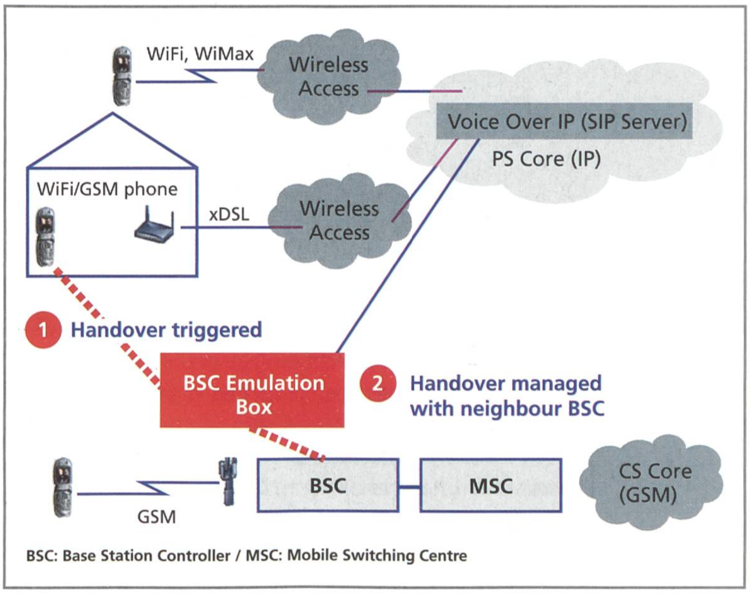

Fig. 2. Seamless handover enabled by BSC emulation.

Third Step of Convergence: the "All-IP World"
This step is foreseen only once a real phase-out of all CS core networks is actively taking place, i.e. both PSTN and GSM networks. This means when all voice and data services are planned to be carried over only one PS core network through different access technologies. Implementing such a paradigm requires only one SIP control plane to gradually implement multimedia services. The IP Multimedia Subsystem (IMS) architecture, being standardised by 3GPP using different IETF protocols, is a strong candidate to implement such a unique SIP control plane for all access technologies (fig.3).

Integrated Backbone in an "All-IP World"
The IMS architecture has been designed to achieve two goals:
- Reuse the strength of the peer-to-peer SIP and related protocols
- Keep control on the operator side by efficiently managing Quality of Service (QoS) on the different access types, securing the authentication mechanism based on the SIM card and establishing roaming agreements with other operators worldwide in a standard implementation

The "all-IP world" vision is for sure compelling for an operator, but so far the handover mechanism between cellular and non-cellular access networks is still unclear (for example Mobile IP based, SIP-based, etc.). A lot of standardisation effort still needs to be done to achieve such a vision. ETSI is actively collaborating with 3GPP in the context of the TISPAN project (Telecoms & Internet Converged Services & Protocols for Advanced Networks) to achieve this goal. This group is a key FMC group at ETSI, discussing specifications

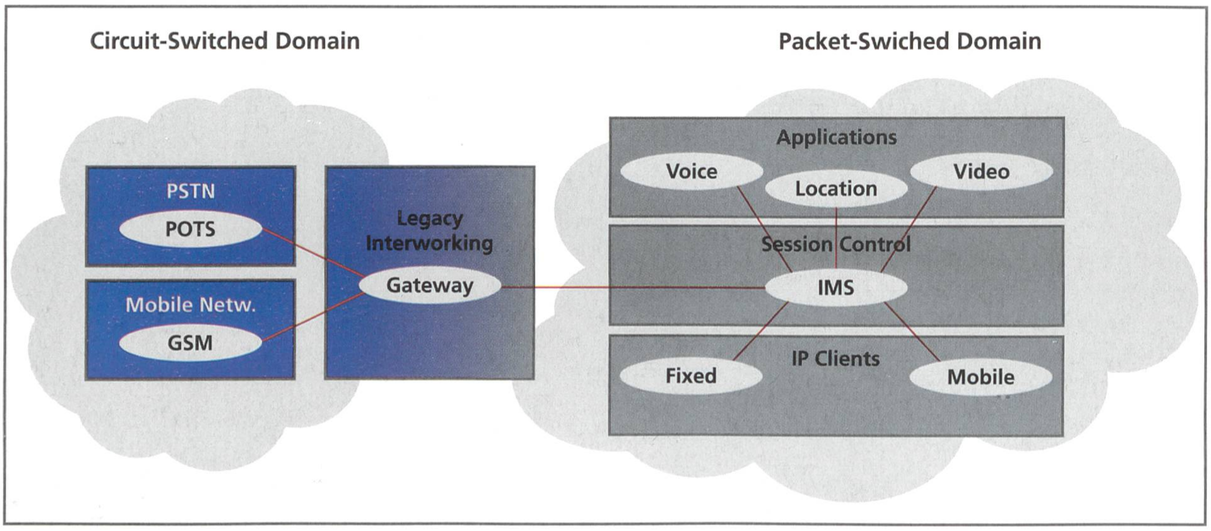

Fig. 3. One control plane enabled by IMS.

based on the unifying IMS standard, for systems that can deliver SIP and traditional telecom services across fixed and mobile networks.
The full specifications are expected in a two-year time frame. In the meantime, an intermediate step would then be to start with non-real-time services that do not have stringent requirements in terms of handover delay. Such services can already profit from one common control plane between fix and mobile using a unique presence server to offer services such as Push-to-Talk.

Conclusion

In this article, the challenges introduced by the integration of different access technologies have been presented. Based on the available technologies and products on the market, a roadmap has been proposed to deal with convergent telephony. In the second step of convergence, two options are available and the choice will be mainly driven by the sensitivity of the end user to the handover delay. In the third step, an IMS platform is foreseen as an enabler for convergent non-real-time services in a first stage. Once handover mechanisms are defined to support real-time services such as VoIP, an "all-IP world" could be implemented.

Even though the focus of this article is not on end devices, it is however important to mention that converged GSM/WiFi phones are still down the road and will be probably available by 1Q06. First prototypes are already available. Challenges that FMC implementation will face will be coming from end devices.

In addition, we clearly see a trend towards a new type of convergence: the merge of communication and entertainment services targeting the residential market. Indeed some companies are already looking at integrating SIP clients or more advanced IMS clients on set-top-boxes.

To achieve an optimal convergence, a clear end device strategy has to be defined in order to avoid missing opportunities in the entertainment business and to be aware of the hurdles that could be encountered on the FMC road. ■

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Nachrichten

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Der neue Public Relations & Communication Officer des «international institute of management in telecommunications» (iimt) der Universität Fribourg heisst Stefan Züger. Er ist PR-Berater BR/SPRG und war unter anderem bei Scout24, Saab Automobile, Opel und dem Schweizer Hotelier-Verein tätig.

Der primäre Auftrag des «international institute of management in telecommunications» (iimt) besteht im Ausbau der Position als führendes nationales Kompetenzzentrum in Lehre und Forschung im Bereich Information and Communication Technology (ICT) Management auf nationaler und internationaler Ebene in einem universitären Umfeld mit interdisziplinärer Ausrichtung. Das Institut wurde 1995 gegründet und hat bis jetzt gegen 500 Studierende ausgebildet. Das iimt ist auch Herausgeberin des jährlich erscheinenden «Telecom Guide Schweiz», der führenden Forschungspublikation über den Schweizer Telecom-Markt. Der «Telecom Guide» ist eine von fünf Serien der iimt University Press.

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