Fixed mobile convergence - some considerations.

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Abstract: This paper provides an overview of the objectives for convergence between the mobile and fixed line telecommunications technologies, with a view to provide telecommunications services to users irrespective of their location, access technology, terminal and service provider. It identifies the benefits of fixed mobile convergence to the users, service providers and the vendors. It also presents a methodology for achieving convergence and outlines the technical factors that will play an important role in achieving the convergence. In the end, the paper provides an example of convergence exercise between a mobile and a fixed network system.

1 Introduction.

Fixed mobile convergence is gaining some attention in telecommunications industry at present. There are service providers and vendors that are interested in the potential benefits it offers. Work is also underway in this area in some standards organisation. The author has been involved in a standardisation project at the European Telecommunications Standards Institute, ETSI, in collaboration with the European Commission, to converge TIPHON with UMTS [1]. The key outcomes and lessons are presented here.

2 Objectives of Convergence

The key question in any convergence exercise is what are you actually converging? This should be defined in the objectives of convergence. In the context of fixed mobile convergence, the objective is to develop a system that supports the users accessing their telecommunications services through a variety of access technologies such as W-CDMA, CDMA 2000, Wireless LAN 802.11, HyperLAN, Ethernet, as well as the traditional means of accessing telecom network including Coax and twisted pair. This seems like a daunting task. But the answer lies in the fact that it is the services that you want to provide to the users, irrespective of the access technology. The services include telephony, messaging, and other multimedia service. Therefore, when addressing convergence of fixed and mobile users, it is the convergence of the functionality in the core networks that we want to achieve.

In the case of mobile communications, 3GPP, the organisation responsible for developing 3rd generation mobile systems, has defined two domains for UMTS networks: Circuit Switched domain and Packet switched domain. The circuit switched domain extends the GSM and other 2nd generation systems' capabilities to the CDMA based access, whereas, the Packet switched domain extends the capabilities based on GPRS and other 2.5G systems. A subsystem within the packet domain, called IP Multimedia Subsystem, IMS, has also been developed. IMS has an architecture that supports multimedia services including telephony and messaging. IMS is IP based multimedia architecture, and is being placed as the target future core network that will provide standardised and unique services to mobile users.

In the fixed line arena, the trend has been to initially converge the traditional circuit switched telephony with the packet switched telephony, including VoIP, and then to migrate the telecommunications networks to the packet switched multiservices networks. A clear trend can be spotted in both the mobile and fixed line evolution towards multimedia services over IP. It can, therefore, be concluded that the packet based core network should be the basis for convergence, so that the services can be developed and deployed once, and provided to users using different access technologies.

3 Benefits of convergence

It is expected that all the players in the value chain of telecommunications industry will benefit from the convergence of fixed and mobile technologies, leading to economies of scale. Some of the players and benefits to them are described below:

- Service providers: Service providers will be able to provide value added services to users on multiple access technologies, and retain and increase their customer base.
- End users: end users will be able to access their services from their home service provider anywhere, independent of the access technology and terminal they use.
- Vendors: Vendors will develop the switching and services related products once and sell them in both the fixed and mobile markets, leading to reduced development costs.

4 Methodology

It is important to devise a consistent methodology for a task as big as convergence of network functionalities. The methodology adopted in this study includes the following operations performed on different candidate frameworks of convergence:

- Analyse the requirements for both network systems
- Identify the key concepts resulting from the requirements
- Identify the key functions that lead to a functional architecture
- Analyse the capabilities of functions
- Analyse the behaviour of functions
- Compare protocols supporting the above capabilities and behaviour.

5 Candidates for convergence

Once it has been established that the convergence should be between the fixed and mobile core networks, it can be achieved by harmonising the concepts, functions, capabilities and behaviour exhibited by these network systems. The key frameworks in both the mobile and fixed network systems are listed below, and should form the basis of convergence.

- Mobility
- Session Control
- QoS
- Security
- Services and Service capabilities

The above frameworks can be used to first compare the candidate systems. The comparison will reveal the similarities and differences between the two systems. The next step is to identify the relevant functions and their behaviour that can be harmonised so that the same functions can be reused in both the mobile and fixed environment.

The following sections discuss the above frameworks in some details.

5.1 Mobility

Mobility is generally associated with users on the move with wireless access capability. However, it is just as important for people traditionally associated with fixed line network, so that the services can be provided to users at different transport points of attachment. A mobility framework encompasses several tasks such as identifying the user requesting a service, location, presence, attributes and preference of a user (user profile), identification of registrar and service node. All of these services should be considered in converging the mobility frameworks. Possible obstacles could be the authentication mechanisms and algorithms deployed, incompatibility in the data required for registration as well as the choice of protocols.

5.2 Session Control

Session control is at the heart of convergence. A converged session control should be able to manage session originating and terminating in both the fixed and mobile environments. There are several aspects of session control that should be considered for the convergence, such as control over sessions, admission control, charging, transport connectivity management, bearer establishment, naming and addressing schemes, address resolution, protocols as well as providing services in home and visited networks.

5.3 Quality of Service

When converging the QoS framework, consideration must be given to aspects such as QoS classes, bearer negotiation and renegotiation procedure, interaction between QoS and Session control, resource reservation, aggregate bearers and any QoS assured pre-conditions.

5.4 Security

The security framework of a system is based on the threat analysis and the countermeasures for the most important threats. In the case of providing services to authorised users, it is important to authenticate them. It is also important to authorise users before providing admission control to avoid unauthorised usage of network resources. Procedures adopted to authenticate and authorise a user should be considered when converging to systems. Capabilities such as 'Privacy', 'Lawful Interception', 'Topology Hiding' at the interconnection interface, and 'admission control' should also be considered.

5.5 Services and service capabilities

3GPP and fixed line standardisation organisation are moving away from standardising services. Instead they are standardising service capabilities, which are the building blocks that can used to develop standardised or unique services. The convergence process should consider the methodology adopted by the converging architectures, as it will have a major impact in any future service creation and deployment. There is a set of supplementary services that are supported by both the fixed and mobile users. An exhaustive list of services required to be supported by both the networks should be compared and supported so that no services are lost due to convergence.

6 Example of convergence: UMTS IMS and ETSI TIPHON

There is an initiative in ETSI to harmonise its TIPHON [3] framework with the UMTS IMS framework [4]. The objective is to develop a system that can be deployed to serve both the fixed and mobile users. The author has used the methodology discussed in sections 4 and 5 to conduct this work and has concluded that whilst IMS and TIPHON were originally developed for mobile and fixed users respectively, there is a major overlap between their concepts, functions, capabilities and behaviour.

A detailed comparison was made between the IMS and TIPHON to analyse the similarities and differences. The comparison also served to identify any gaps between the two systems, and to fill these gaps, where relevant.

IMS relies on the PDP context establishment to gain access to the data network, whereas, TIPHON, being a generic framework has not specified the use of any of the access technologies. It is therefore, not possible to compare the capabilities and procedures required to attach to the transport network, to access the services provided in the network.

There are differences in the QoS area that need to be resolved. 3GPP requires the support for the concept of QoS assured pre-conditions, which allows a terminal to receive session set-up request along with QoS conditions, and negotiate these conditions before the user is alerted. This method has been adopted in 3GPP to increase efficiency of the radio interface. The concept of end-to-end QoS is different in TIPHON and IMS. Similarly, the concept of QoS classes in IMS is different from TIPHON.

Both the IMS and TIPHON have developed their own 'profiles' of SIP protocol for use in their respective environments. Comparison of SIP profiles reveals a big gap in capabilities supported by IMS and TIPHON. It should be noted that IMS has extended SIP to serve its particular requirements, some of which are specifically related to the behaviour of the radio interface. When converging the SIP profiles, it may be desirable to separate the transport specific capabilities from those that are common to both the mobile and fixed environment. This will lead to a clear set of 'add-on' capabilities that specific to a certain environment.

The area of most difficulty to achieve convergence is that of Service Capabilities. IMS relies on the OSA architecture to define its service capabilities and features, which has a different level of granularity from TIPHON service capabilities. Work is continuing in this area.

The gap analysis has revealed certain areas where one of the systems has developed a capability required by the other. This can help the system requiring the capability to either adopt the capability or work in collaboration with the other. E.g. IMS requires the 'Privacy' of a user to be supported at both the application and transport level. This means that the identity and address of the calling user should not be presented to the called party either in the session set up message or via the transport stream. IMS currently supports application level privacy. TIPHON has developed the 'privacy' capability for both the application and transport levels that can be adopted by IMS.

Another area for collaboration is the 'user profile development'. User profile plays an important role in all aspects of providing services to a user in a distributed environment such as that of IMS and TIPHON. IMS has developed the framework for a Generic User Profile and has not specified the data elements for it. TIPHON has specified the data elements required for its 'user profile' but not the framework for managing this data. TIPHON and IMS can clearly work together on this to converge this area.

7 Conclusion

Fixed and mobile convergence is an enormous task, but it has clear benefits. It is expected that a certain level of convergence will be achieved but not 100%. There will be some variations in each network type, addressing the particular requirements of that network system. At best, convergence will lead to a system that will serve both the fixed and mobile user with minor variations. This is reflected in the convergence of 3GPP IMS and ETSI TIPHON. A way forward to success is collaboration between the standards organisation developing these next generation systems.

References:

[1] ETSI draft standard DTS/TIPHON 00003 draft version 010.

[2] IMS stage-2. 3GPP draft standards. 23.223

[3] TIPHON website: http://portal.etsi.org/Portal_Common/home.asp

[4] 3GPP website: www.3gpp.org