Evolving to IMS as the Convergence Platform

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Abstract—**With the emerging trends of convergence, there is increased enhanced possibility of offering seamless services to the user. Bandwidth intensive applications like games, multimedia and video are being provided across different types of networks. We would discuss the role of IP as the common platform enabling network convergence and also point out the barriers in achieving network convergence. We would also highlight the importance of interoperability of IMS products thus realizing an IMS based platform for enabling efficient deployment of new multimedia communication services.**

Keywords: mobile ip, fixed-mobile convergence,SIP,OMA

I. Introduction

With the trend of convergence the subscribers are demanding higher data rates and higher quality mobile communication services. The evolution of telecommunications is providing the platform for integration of all communication applications on a single system.[1] IMS is an emerging system which has a hierarchical architecture consisting of IP based core network providing converged services to wireless, wireline and cable subscribers.[2] It will be IP based platform that would enable easy and efficient deployment of new multimedia communication services

Access technologies such as DSL have enabled operators to leverage their existing network and reshaping the entire network. New services are being rolled out such as VoIP, IPTV, triple play and other internet based technologies.IMS network is a collection of different interfaces grouped from one IMS network. Communication services such as multimedia telephony, push to talk and instant messaging are offered by the IMS over a session initiation protocol. The application servers in IMS host and execute the logic services. IMS with its openness and integrating nature can accommodate other access networks including GSM and CDMA cellular networks, cable TV networks, WiFi and other enterprise and residential networks.

II. IMS as integrating platform

Network operators can provide convergence through voice, video and data thus using a single platform. IMS makes it possible to provide communication between fixed and mobile phone users. IMS also provides vendor independence since multiple service providers can integrate different components into the same system. The gateways also provide interconnection with legacy telecommunication systems providing optimization of the investment. QoS is also enhanced and meeting up the requirements of the subscribers thus making IMS the optimum platform for NGN. The new services enabled by IMS include VoIP, conferencing, rich call features, multimedia gaming and voice messaging.

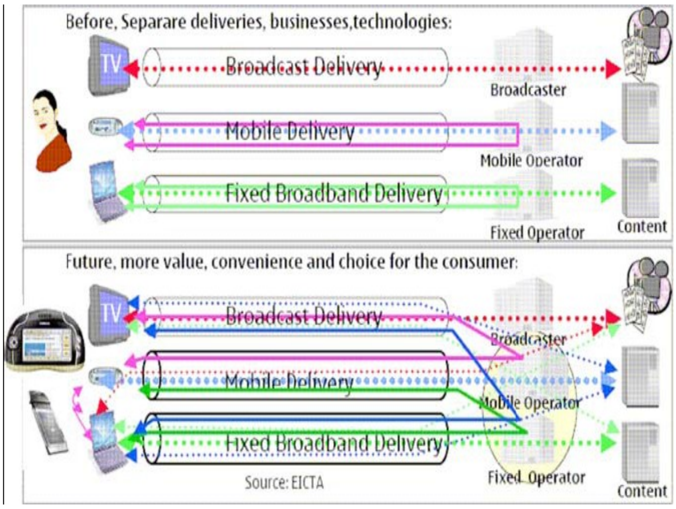

Figure 1. Fixed-Mobile Convergence over the IP Infrastructure.

III. Interoperability

Interoperability is ensured to avoid any unrequired issue arising from non compatibility. Due to increasing complexity of the specifications it is becoming common to test all the specifications since there may be unpredicted issues arising.[3] Without good interoperability, there would be problems for customers to operate their devices on different networks and would be a source of dissatisfaction for the customers thus possibly making the company lose the valued customers. IMS provides common functionality such as charging support, session and service control, subscriber management and mobility management for IP based multimedia services through well defined reference points to the higher service layer.

IV. Mobility requirements in the evolution to IMS

The backbone of the wireless access network is the core IP network. The point of attachment of the mobile terminal changes as it moves from one access point to the next. These access points terminate in the core network and therefore, historically, mobility solutions have been developed at layer 2 which because of the underlying physical transport, minimize latency in handovers.[4] Since the mobile terminal can come across multiple access technologies and can run a wide variety of applications, network layer, i.e. , the IP layer which is the binding layer between the applications and the layer 2 , that has been standardized to run across the different physical layer mediums also separating the upper layers from the lower MAC and PHY layers. So there is a significant drive in the IETF to develop extensions to IP protocols to support host mobility.

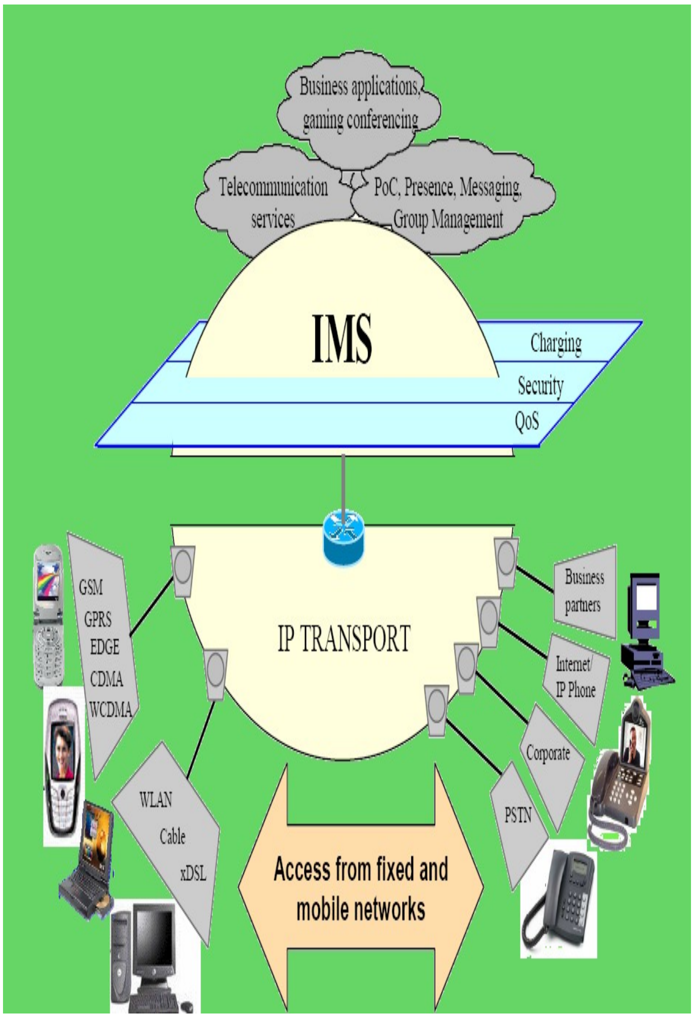

Figure 2. IP based Fixed-Mobile and Mobile-Mobile Convergence

In the existing internet architecture, an IP address is assigned to a stationary node or it gets dynamically using the Dynamic Host Configuration Protocol (DHCP). In both cases they have the topological significance in routing. When talking about mobility, a node would have to change its point of attachment and therefore must be assigned a new IP address which needs to be binded with the original IP address in the home network to ensure proper routing of the packets between the mobile host and the corresponding (destination) node. IPv6 has also been developed as evolution to IPv4. Both are dual operational i.e., basic operation and route optimization. In IPv4, the tunneling is through the home agent and in the later mode the home agent is bypassed after initial negotiation and a direct path is established between the mobile node and the corresponding node. In MIPv6 the advantage is that there is no foreign agent in MIPv6 since as a requirement every mobile node must support IPv6 decapsulation, address auto configuration, and neighbor discovery. The mobile node in MIPv6 uses care-of-address as source address in foreign links which solves the problem of ingress filtering. While MIPv6 has its advantages over Mobile IPv4 a significant challenge faced is the MIPv4 is already operational in the field.IPv4 nodes and IPv6 nodes are only functional in their respective works and not interoperable which is a major issue. So the future deployment of IPv6 has to be worked out for speedier optimization of the problems.

The internet is based on IP addresses and domain Name Service (DNS) names. The IP addresses, which may be assigned statically or dynamically are tightly coupled with the host addresses and Domain names provide hierarchically assigned names to some services e.g., HTTP, email, SIP addresses all refer to Domain Names. The IP executes the functions e.g., host location, host name, interfaces, TCP connection identifiers. The Internet Task Force was also involved in studying the need for separate namespace between the applications and the network (IP) layer. This would also separate the host address from the interface address to allow for more flexibility.

There is a big push towards multiple access terminals and handovers across different access technologies. This would also be a potential challenge as each radio interface would have its own port which raises the issue of coordination among the ports, IP addresses, host names and their security/authentication associations.

V. Converged Architecture Approach

The trend of converging 3G and NGN networks is appealing to operators who can consolidate their network with the help of IMS. The concepts of IT and data services integrated with communication leads to the demand for more sophisticated communication services such as group management.

The internet acts as another access network, alongside 3G Mobile networks, enterprise IP VPN networks and NGN IP networks. Fixed IP networks include several access methods, namely xDSL, cable, or Metro Ethernet. Fixed wireless LAN, WiFi and WiMAX must be supported by the future integrated network.

A. Technical Issues

Standards Maturity SIP in the initial stages was to replace the SS7 protocol but due to its flexibility could not provide

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unambiguous interfaces. Extensions had to be defined and the enhanced SIP no longer simple to implement. Since the converged architecture of IMS can support all types of access networks so existing IMS specifications were extended and new functions needed integration. This process obviously took time and globally approved specifications had to be also delayed. Vendors have to address this issue also and provide their own extensions where the standards are not available.

B. *Performance*

There are other problems as well like echo cancellation, jitter and latency which were already resolved for IP trunking and carrying voice for long haul over IP networks. Full SIP solutions have to be proven for high performance, adequate quality levels and large scale networks. The performance in IMS can be affected by the extensive processing of longer session descriptions and lengthy addresses and by multiple hops between several servers. This would occur in roaming as well as within the same network. In view of these concerns many working are set to optimize performance thus addressing the weakness points and computing advanced technologies like parallel processing.

C. *Database Issues*

The retrieval of data by several nodes (applications and session controllers) from the central data storage, the HSS and can create another bottleneck. To alleviate this there should be an efficient data replication mechanism.

D. *Secuity and Privacy Issues*

There is an increased chance of spam and fraud in the scenario of IP/internet space. Since frequent and large amount of information which is often confidential indicates the significance of security issues. VoIP and other telecom services are not immune from the potential threats so appropriate measures have to be taken to protect the confidential data from the external hackers.

E. *Migration*

Migration issues exist relating to the current customer base pertaining and existing equipment. For an early stage it could be easier to migrate to an interim solution that delivers packet voice based on H.248 not fulfilling IMS multimedia based on SIP. We also have the option to choose temporary solution (softswitch) or a long term solution (IMS based PES) to support those subscribers who would prefer to keep their traditional phones while the transport network migrates to IP. Mixed Signaling protocol environment has to be existing for the migration period for interworking with the complex and varied legacy signaling while moving to SIP and IMS. The successful revenue earning services would continue to benefit the customers despite moving the core to IMS, e.g., call centers, premium rate games, or location-based advertising.

F. *Investment*

Investment extending the successful services over the new access-agnostic IMS enables for additional access methods (e.g., WiFi , WiMAX, or PBT) would require new investment and further decisions according to the access method to be adopted.

G. *OMA Approach*

The OMA (Open Mobile Alliance) concentrates on service delivery, capability, rather than session admission and session control. The OMA recognizes IMS type of services and non-IMS services. Non-IMS services can be Web services, data-centric services, near-real-time services, or machine-to-machine services. The OMA defines service enablers for both types of services. The applications can access these enablers directly, for exchange of information that is outside the scope of IMS. One of the functions of OMA is to ensure interoperability. There is no doubt about the significance of validating the specifications before releasing them. The complexity of the produced enablers and the popularity of testing events forced the creation of proper conformance testing and to ensure that immature implementation would be filtered.

The conformance testing ensures to identify the potential problems before confirming the interoperability and to encourage companies to develop uniform and consistent implementations to minimize the problems. An additional time and finances would be required to develop a proper test system for conformance. The issues related to the interoperability are not dealt by OMA but rather through some organization that specifies IMS. However, as the interoperability testing of the PoC enabler also performs the testing of IMS, some IMS interoperability issues already were found. There are ambiguities in IMS specifications that led to different implementations and problems different vendors' implementations must solve in order to interoperate. OMA leveraged the rise of both the SIP protocol and the IMS architecture, in a detailed study, to ensure that service enablers based on SIP are developed in an interoperable manner. The reusability of IMS interfaces is defined within the context of the OMA service environment. OMA specifies several service enablers that rely on the capabilities of an underlying SIP/IP core network. The SIP/IP core is understood as s service layer containing a number of SIP proxies and SIP registrars. It performs the following functions to support SIP based service enablers developed in OMA. [5]

The ip core routes the SIP signaling between the PoC client and the PoC server. It also provides discovery and address resolution services, including E.164 address resolution and supports SIP compression performing authentication and authorization of the PoC user at the PoC Client , based on the PoC user's service profile maintains the registration state. It also provides support for identity privacy on the control plane and provides charging information as well as providing capabilities to lawful interception When SIP/IP core is based on 3GPP IMS, the SIP/IP core is specified. To ensure the interoperability of OMA service enablers, the interoperability of IMS systems in different providers' networks is crucial to ensure that the previously listed functions are working properly.OMA has the potential to define service enablers that use IMS capabilities for its SIP based service enablers in a consistent and effective way. Those enablers , for example, are presence SIMPLE V1.0, IM SIP/SIMPLE V1.0, push-to-talk over cellular PoC V1.0, and SIP push V1.0.The PoC enabler is specified as a SIP based service enabler utilizing IMS/MMD capabilities (defined in 3GPP and 3GPP2), as well as standard protocols defined by the IETF.

The converging architecture of IMS would devices to access common services over one or more network easily. The need for seamless mobility and simplicity of management and operations and along with unified common packetized method of transport are driving the evolution towards and IP centric architecture. The lower opex and capex also contribute towards adopting the IMS when it is compared to traditional circuit switched network.

VI.IMS AS CONVERGENCE TOOL

The convergence would be introduced in both user plane which is IP-based, and mobility management at the IP layer. Fixed Mobile Convergence would be based on IP Multimedia Subsystem. IMS was originally developed for mobile service providers and was later adopted and endorsed by ETSI/TISPAN.IMS compliance is the core of NGN and defines a network domain with emphasis on controlling and integrating multimedia services.IMS uses a standardized Next Generation Networking architecture for telecom operators that want to provide mobile and fixed multimedia services. It uses a VoIP implementation based on SIP protocol. SIP is used for call control and is access independent as it supports an IP session over all types of packetized access networks along with GSM/EDGE/UMTS and fixed networks. User services and peer to peer real time services would be supported over PS Domain. FMC would be achieved by building everything on SIP, COP, DIAMETER and optimizing these for mobility by combining both the packet switched and circuit switched networks.

IMS Terminals: IMS phones are available which work over the converged fixed-mobile network implementing the same set of IMS standards Generic Access Network enabled handset allows seamless roaming between the public radio such as Wi-Fi and GSM/GPRS service using the same number while running the mobile services Thus this is a platform to integrate Wi-Fi voice and data with GSM. There is also reduction in the bandwidth burden from the licensed band to the unlicensed band while it also provides better coverage in areas where cellular coverage may be poor or non-existent. All the handoff processes are controlled by a network element

VII. CONCLUSION

IMS has brought a revolution in mobile networks and some questions are yet to be addressed in implementing it but the situation is changing fast and IMS is capturing the mobile market. The demand for various services to be provided on a single platform has increased tremendously and the companies are moving towards broadcasting rather than confining their operations to the same service area. More steps are being taken to give the IMS a comprehensive and converged network environment The packet oriented communication networks would mean that all the future applications and services would be delivered over the IP logical network. The Fixed –Mobile convergence would occur at the IP layer along with support at the MAC layer. There is rapid development of VoIP, video over IP and other multimedia services for which standardized control infrastructure would be implemented for far reaching effects. The promising "always on" experience is also practical for any network connected device.IMS would be included by every major telecom service provider in strategic planning.IMS is significantly a complex framework but adds meritoriously to the wireless networking environment. The complications give the opportunity of challenging research in this revolutionary networking system of all the times.

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