Chapter 3
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IP Multimedia Subsystem (IMS) defined by 3GPP [2] and 3GPP2 [1] standardized based on IETF Internet Protocols. Most of researches in Next Generation Network enable IMS has been focused on the engineering, rules, protocol, service provision in IMS, compatibility issues and refinements of SIP with IMS. Researches also worked over convergence of IMS service, Service orchestrations. Next Generation Network enabled other technologies including wireless, wireline integrated with IMS for service provisions.

This research is based on IMS stage 2 [1], release 6 and release 7. IMS is access independent as it supports IP to IP session over wire-line IP, 802.11, 802.15, CDMA, packet data along with GSM/EDGE/UMTS and other packet data applications. It consists of session control, connection control and an applications services framework along with subscriber and services data. It enables new converged voice and data services, while allowing for the interoperability of these converged services between subscribers. Considering wide spread usage of IMS enable services, the researches also enlightens IMS service provision paid much attention many research also focuses on Service Enhancement, Quality of Service, Quality of Experience of end user, Charging, Convergence of Service.

Before initiate core part of this research work, a brief study recent work had been done on IMS from Springer Proceedings, Bell Labs Technical Journal, IEEE as well other research groups publications [50], [51], [52], [53], [54], [55], [56], [57], [58], [59]. The crucial issues involved in these works are:

a. IMS Architecture for service design, modeling and provisioning
b. Service management for IMS Network; including service provision, mobility, service management, charging and subscribe data management
c. Instant messaging and Presence service existing in-depth study as well as traffic load balancing for Providing comfort service integration with IMS networks
d. Subscriber data management and data integration so that IMS applications can use single point of access for accessing user profile information inside a service providers network
e. Threats and vulnerabilities of IMS implementations as well as high-level service provider security requirements to provide the desired level of security for IMS deployments.
f. Data management work and issues for IMS, existing subscriber's data management; concerns for charging and subscriber's management.

With respect to vast spread of IMS applications and usage, provide a break down of the literature review related to research next phase.

3.1 IMS Architecture & Session Initiation Protocol Issues

IP Multimedia Subsystem (IMS) is standardized network architecture for telecom operators that want to provide mobile and fixed multimedia services. IMS Architecture modifies as per service provision and service integration schemes. Many researchers had work in this aspect specially focuses on service integration and provision over IMS.

M. Koukal, R. Bestak [60] provided IMS Architecture with concern of IMS in existing network. This research had also covering Core IMS Network with IMS Architecture functionalities. They focus on how IMS is connected to operator's networks and described the IMS architecture. Furthermore, the study listed the most important IMS system components and described their roles in the integration of IMS with the telecommunications networks. Brief discusses the IMS Inter working of CSCF, HSS, and MRFC. Focus of this research towards IMS-VXML service integration, which works to control Media services from Media server, including a little survey of charging process. They assume MRFC with standard H.248/Megaco protocol; other future research discusses about other protocol works with MRFC. This research had not discussed content charging as well as service convergence over IMS.

Jonathan Cumming [61] presented their work on Overview of session boarder control including its security monitoring aspects. In this research Jonathan discussed brief era on IMS Architecture including User plane, IMS architecture for SBC and SBC Functional Evaluation. State of Art work represents Future of IMS services, concepts of Service Integration with IMS Architecture. In their research, brief discussion taken on User Plane, and SBC integration, Monitoring, Management. But Charging concept with SBC not mentioned.

Dutta, A. & other members in [62] had discussed about Advances to IMS (A-IMS) architecture extends the existing IMS/MMD architecture. Regarding their research they had implemented Advance to IMS architecture and performance with SIP and non-SIP-based services. As well as Interaction between SIP and Non-SIP based service provided over Advance to IMS. With this work they had shown Strengths of IMS Architecture as well as capacity of working IPv6. This research had also implemented functional components of testbed as well as with performing such operations like signaling, location management, security, and mobility.

Many researchers had worked on IMS Architecture with additional service convergences and interface modeling. Xianghan Zheng, Vladimir Oleshchuk, Hongzhi Jiao [63] has worked toward realize the convergence of the fixed or mobile networks at network level, with providing IMS application for establish a uni-platform for providing services, no matter which access technology is used. This research also enlightens limitation of device capabilities, a majority of legacy devices (e.g. mobile phone, PDA, laptop, etc). A state-of-art work based on Thin Client IMS System is proposed with this research, discusses a brief convergence and service modeling with IMS with Non-IMS client devices. Some additional issues also covered regarding security, provisioning, identity management, Thin Client Inter-working, IMS Inter-working and device management are main concern for their research. In [63] researcher had not brief charging parameter with any service example, then also concern with other aspects of IMS finger point for IMS system architecture management, and prototyping design validation concepts.

3.2 Quality of Service Issues

Over the past few decades various Quality of Service (QoS) issues have evolved on wireless communication. Scheduling/queuing is one of the areas that drive researchers to ameliorate performance analysis of wireless network. The scheduling can be found in top to bottom layers of the network in order to achieve efficient network admission control for instance, in terms of reliability, energy efficiency or resource utilization etc. Two different approaches may be distinguished as far as admission control is concerned: reservation-based and measurement-based. In the first approach, new flows specify their QoS requirements along with their traffic descriptors through a signalling protocol such as Resource Reservation Protocol (RSVP).

Analysis of performance metrics based on network parameters like number of servers, arrival rates of traffic into the network and service rates can ensure efficient resource utilization while providing the promised QoS. Capacity planning of IMS based networks will be simplified if effective trends of performance can predicted quickly.

The amount of resources to be allocated to an incoming flow is computed accordingly. In the measurement-based approach, resources are not dedicated to a given flow. Hence, the admission criterion does not depend on the amount of reserved resources, but on their real utilization for instance, a link. Recently there has been a growing interest in applying admission control to elastic flows of classified traffic.

Eyers and Schulzrinne [64] cover SIP call setup delay based on SIP and H.323 traces from the Surveyor database. The Surveyor project provided the continuous delay and loss statistics for UDP packets between selected cities. The focus is on delay due to UDP loss and assumptions are made about the processing times of tasks.

Kist and Harris [65] present signaling delays in 3GPP with emphasis on DNS lookups. They assume the queuing delays to be less than 5 ms based on current web server implementations and assume the SIP servers to have exponential service distribution.

Network Dimensioning is another key capacity planning discipline, which has a direct impact on a network's cost base. An excess of deployed capacity will result in wasted capital, while a dearth of capacity will adversely impact service level agreements, potentially incurring service penalties. The key features of the Network Dimensioning service include determining the appropriate sizing approach required for the network, defining key inputs for the dimensioning exercise, such as a traffic demand matrix, routing configuration files, network topology, resilience requirements, etc., optimizing the routing of traffic by using features such as traffic engineering, defining a bandwidth augmentation strategy and characterization of network workload etc. Mobility management is a significant field where researchers are putting much effort.

Perkins [66] was very first to introduce and brief mobility support in Internet Protocol (RFC 3344). Mobility support in IP worked like a tonic for other prominent protocols in communications. It is still a significant area for the researchers. The mid call mobility management has been observed in quite a few work. Reducing message overhead and location based performance analysis are other key factors today in mobile environment.

Haase [67] propose a unified mobility manager (UMM) for effective inter-working of wireless networks and voice over IP networks. The UMM reduces performance degradation by combining UMTS Home Location Register (HLR) and SIP proxy functionality in one logical entity. The focus is on integration of SIP in UMTS with PSTN [67]. Curcio and Lundan [68] study SIP call setup time in 3G networks and compare it with call setup time over LAN networks. The effect of SIP calls over lossy channels with restricted bandwidth is also studied.

3.3 IMS Security Aspects & Issues

Unlike any Network, The IP Multimedia Subsystem (IMS) provides a powerful session and service architecture creating a platform for next-generation user services. [52] Erik E. specifies a security approach and architecture is required to address the vulnerabilities inherent to Internet Protocol (IP)-based solutions. The security architecture is driven by 3GPP and 3GPP2 security standards along with the security model described in International Telecommunications Union (ITU) Recommendation X.805, Security Architecture for Systems Providing End-to-End Communications. With this research they perform examination on various threats and vulnerabilities of IMS implementations as well as high-level service provider security requirements, and defines an implementation approach to provide the desired level of security for IMS deployments.

This work mainly studied for purpose of setup of Testbed at I2IT Wireless Network Laboratory. As OpenIMS core setup deployed through this literature study. As work is mainly focusing on Service Deployment and Modeling, then also make much concern on threats on service implementations as well as vulnerabilities of IMS Implementations, Service provision phase.

3.4 IMS Service Integration

IP Multimedia Subsystem focuses on new and innovative service provision, but this task passes through service design, deployment, service integration and Service management. [63] Xianghan Zheng, Vladimir Oleshchuk and Hongzhi Jiao has discusses Architecture for SIP based IMS architecture for Multimedia Services integration process. In this research a state-of-art approach for designing propose a browser-based Thin Client IMS System Architecture to support non-IMS Client devices. Major issue discussed is to consider security evaluation as well as identity management in service provisions. With this research, researcher had also in-depth description of Thin Client Inter-working as well as IMS Inter-working and device management and the prototype to validate the design concept.

3.4.1 Existing work in Presence Service for IMS

Communication network mainly demands for new and Innovative service, [55] Jacco Brok, Bharat Kumar, Erik Meeuwissen, Harold J. Batteram discusses brief regarding New Sevice in IMS. The IP Multimedia Subsystem (IMS) architecture enables a new class of converged, multimedia services for subscribers. This paper examines the role of presence information in IMS to provide personalized treatment of voice over Internet Protocol (VoIP) calls, multimedia sessions, and instant messaging (IM) interactions. This can be achieved with an IMS application server that interacts in a standardized way with IMS elements (S-CSCF and HSS) and other elements such as the presence server. With this research a clear approach mention regarding new and innovation service integration in IMS Networks.

Researcher for this work performed [55] most estimable architecture that extends the much service integration like Instant Messaging, presence etc., and concept to a broader class of context information. Many factors of presence discussed like source, real-time availability, and duration, and its respective characteristics. Also discuss how attributes can be gathered, monitored, filtered, and stored efficiently using a hierarchical architecture. This includes incorporation of external presence and context information, such as emergency and enterprise calendar data, in a secure and privacy-sensitive manner.

A key advantage of the IP Multimedia Subsystem (IMS) is that it promotes the development of innovative multimedia services designed to bring an enhanced experience to the end user. Carlos Urrutia-Valdés, Amit Mukhopadhyay, Mohamed El-Sayed [58] presented real time IMS application architecture for Presence service. Basically Presence service comes from Chat, IM applications. With this research work they have shown state of art work regarding presence and availability service is viewed as an indispensable feature for these next-generation enable IMS Network services to help service providers generate new revenue and reduce churn. Numerous new services are currently being designed to take advantage of this feature. They have also examined presence and availability in the context of IMS and with application architecture defined by 3GPP/3GPP2 and IETF. They also discuss briefly regarding traffic analysis for Presence user management as well IMS enable network capacity with their impacts for real time implementation issues concerns. Some relevance concerns also provided in the area of analysis of presence updates and propose a user model and a traffic model to quantify the signaling traffic that such a feature can generate on a network. With this discussion able to get model, network designers can examine the processing requirements for presence servers and other IMS components like CSCFs, MRF with which costing / charging structure may affected in IMS Network.

The Presence Information Data Format (PIDF) is a protocol-agnostic document that is designed to carry the semantics of presence information across two presence entities. The PIDF is specified in the Internet-Draft “Presence Information Data Format (PIDF)” (RFC 3863). The PIDF encodes the presence information in an XML (Extensible Mark-up Language) document that can be transported, like any other MIME (Multipurpose Internet Mail Extension) document, in presence publication (PUBLISH transaction) and presence subscription/notification (SUBSCRIBE/ NOTIFY transaction) operations. The Rich Presence Information Data Format (RPID) is an extension to the PIDF that allows a presentity to express detailed and rich presence information to his/her watchers. Like the PIDF, RPID is encoded in XML. The RPID extension is specified in (RFC 4480).

Presentity like Alice for instance can set her rich presence information by manually operating on the appropriate setting of her presence software. However, RPID allows an automation that has access to the presentity's presence information to set such information up automatically. For instance, a calendar application can automatically set the presentity's presence information to “online - in a meeting” when the presentity's agenda indicates so. A SIP phone can automatically update the presentity's presence information to indicate that the presentity is engaged in a call when the presentity answers the phone. The RPID contains one or more activity elements that indicate the activity the presentity is currently doing. The specification allows the activity element to express that the presentity is on the phone, away, has a calendar in a meeting, steering a vehicle, in transit, traveling, on vacation, sleeping, just busy, or on permanent absence.

For instance, a place-type element in the RPID indicates the presentity currently in. the possible initial values are home, office, library, theatre, hotel, restaurant, school, industrial, quiet, noisy, public, street, public transport, aircraft, ship, bus, train, airport, station, mall or outdoors etc. The list of values is expandable for future extensions.

Below Figure 3.1 code shows an example of the presence information that Alice provides to her watchers.


```
<?xml version=”1.0” encoding=”UTF-8”?>
<presence xmlns=”urn:ietf:params:xml:ns:pidf”
xmlns:es=”urn:ietf:params:xml:ns:pidf:rpid-status”
xmlns:et=”urn:ietf:params:xml:ns:pidf:rpid-tuple”
entity=”pres:alice@example.com”>
<tuple id=”3bfua”>
<status>
<basic>open</basic>
<es:activities>
<es:activity>meeting</es:activity>
</es:activities>
<es:place-type until-“2006-01-17T11:30:00Z”>
Home</es:place-type>
<es:privacy>quiet</es:privacy>
```

```xml
<es:idle>2006-01-17T09:4600Z</es:idle>
<es:sphere from=“2006-01-17T09:00:00Z“>work</sphere>
<status>
<et:class>sip</et:class>
<et:contact-type>service</et:contact-type>
<contact priority=”0.8”>
sip: user1@imstestbed.net
</contact>
<timestamp>2006-01-17T10:32:16Z</timestamp>
</tuple>
<tuple id=”vusa44”>
<status>
<basic>open</basic>
<es:privacy>quiet</es:privacy>
</status>
<et:class>phone</et:class>
<et:contact-type>device</et:contact-type>
<contact priority=”0.8”>
im:user_public@dodo.com
</contact>
<timestamp>2006-01-17T10:32:15Z</timestamp>
</tuple>
<tuple id=”tan45”>
<status>
<basic>open</basic>
</status>
<et:class>mail</et:class>
<et:contact-type>device</et:contact-type>
<contact priority=”3.0”>
mailto:user2@imstestbed.net
</contact>
</tuple>
<note>I am working on IMS at home</note>
</presence>
```

Figure 3.1 Example of the RPID

The first tuple in Figure 3-1 indicates her own presence information to be active or open, but at the meeting etc. The second tuple conveys the presence information of her phone while the 3rd indicates a mail contact where she could be reached via email. After a presentity publishes its presence to its Presence Agent (PA) / Presence Server (PS) via RPIDs, the PS keeps the presentity's watchers updated with NotifyPresUp messages (see Figure 3-2).

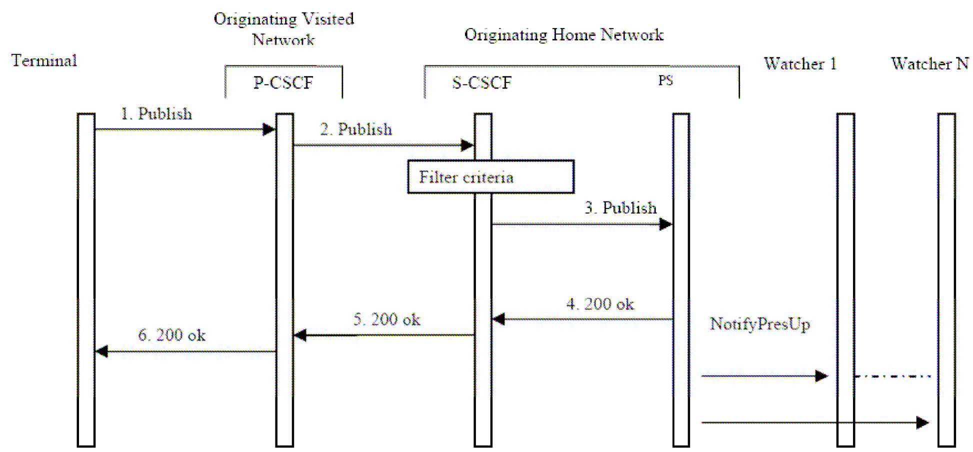

Figure 3-2: Publishing and notifying presence information

A watcher receives NotifyPresUp messages from the PS based on the RPID, every time a presentity of its list changes state. These XML documents with presence information can be rich in data compared to the processing capacity of a small wireless device. Obviously, this mechanism does not scale well, particularly in wireless environment since the heavy transmission rate can easily overload an IMS network with message flows. Objective is to propose an efficient scheduler for the PS in heavy traffic situation.

Subscription / Registration time

The detail of SIP and MIP registration can be located in (RFC 3261) and (RFC 3775) respectively. Related work can be found in (RFC 3344). Multi-cast support for MIP with Hierarchical local registration has been presented by Omar et al [69]. The Timed Presence extension is specified in RFC 4481, "Timed Presence Extension to the Presence Information Data Format (PIDF) to indicate Presence Information for Past and Future Time Intervals" and allows a presentity to express what they are going to be doing in the immediate future or actions that took place in the near past.

A timed-status element that contains information about the starting time of the event is added to the PIDF XML document. The starting time of the event is encoded in a 'from' attribute, whereas an optional 'until' attribute indicates the time when the event will stop. Figure 3-3 shows an example of the time status extension.

Here, Alice is publishing that she will be offline from 13:00 to 15:00.

```
<?xml version=”1.0” encoding=”UTF-8”?>
<presence xmlns=”urn:ietf:params:xml:ns:pdf”
xmlns:ts=”urn:ietf:params:xml:ns:pidf:timed-status”
entity=”pres:alice@example.com”>
<tuple id=”qoica32”>
<status>
<basic>open</basic>
</status>
<ts:timed-status from=”2004-02-15T13:00:00.000+02:00”
Until=”2004-02-15T15:00:00.000+02:00”>
<basic>closed</basic>
</ts:timed-status>
<contact>sip:alice@example.com</contact>
</tuple>
</presence>
```

Figure 3-3: Example of the timed status extension

A subscription can last for a period of time. If watchers want to keep the subscription active they need to renew it prior to its expiration. The PS will keep the PUA/IMS user updated, using NOTIFY requests about changes in the list of watchers. That is, it will inform presentity every time a new watcher subscribes or un-subscribes to the presentity’s presence information. Every time a watcher wants to subscribe to the presence information of a presentity, the watcher needs to exchange a SUBSCRIBE transaction and a NOTIFY transaction with the presentity’s PUA, just to set up the subscription. Obviously, again this mechanism does not scale well, particularly in wireless environment for small devices.

3.4.2 Presence Optimizations by IETF

In order to solve these above-stated problems of frequently notifying watchers (via NotifyPresUp message) due to the presentities’ state change and notifying Presentities (via NOTIFY message) due to the watcher subscription time expiration, the IETF has created a number of concepts as described below.

1. The concept of resource lists is one of the mechanisms to reduce excessive signals. A resource list is a list of SIP URIs that is stored in a new functional entity called the Resource List Server (RLS) sometimes known as an exploder for SUBSCRIBE requests. A SIP exploder receives a request from a user agent and forwards it to multiple users. SIP

exploders used for subscriptions are described in RFC 4662. Figure 3-4 shows how this type of exploder works. Instead of sending a SUBSCRIBE request to every user in the presence list, Alice sends a single SUBSCRIBE request addressed to her presence list. The SIP exploder, or RLS receives the request. Alice has previously provided the exploder, using an out-of-bound configuration mechanism of her choice, with her presence list. The exploder sends a request to every user in the list. Later when the exploder receives the NOTIFY requests from them, it aggregates the presence information and sends a single NOTIFY request to Alice. Although the mechanism saves bandwidth on a user's access network, the signalling impact is still there for massive number of publishers and watchers.

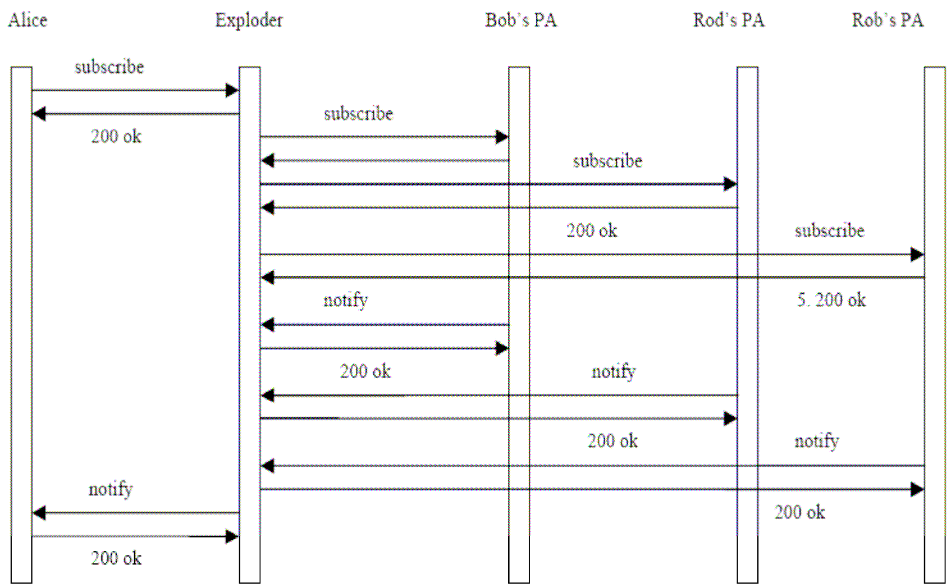

Figure 3-4: Resource list through an exploder [69]

2. Event filtering (RFC 4660) is one mechanism on which IETF engineers are working to reduce the amount of presence information transmitted to watchers. A weight or preference is indicated through a SUBSCRIBE request. The mechanism defines a new XML body that is able to transport partial or full state. Thus, the document size is reduced at the cost of information transmitted. Sending less information in presence documents may lead to IMS users not getting a good experience with presence systems used from wireless terminals. Also, the implementers need to be aware of the computational burden on the PS.
3. Event-throttling mechanism allows a subscriber to an event package to indicate the minimum period of time between two consecutive notifications. So, if the state changes rapidly, the notifier holds those notifications until the throttling timer has expired. Usually, the PS will buffer notifications that do not comply with the throttle interval, and batch all of the buffered state changes together in a single notification when allowed by the throttle. The

throttle applies to the overall resource list, which means that there is a hard cap imposed by the throttle to the amount of traffic the presence application can expect to receive. With partial-state notifications, the notifier will always need to keep both a copy of the current full state of the resource F, as well as the last successfully communicated full state view F' of the resource in a specific subscription. The construction of a partial notification then involves creating a difference of the two states, and generating a notification that contains that difference. When a throttle is applied to the subscription, it is important that F' is replaced with F only when the throttle is reset. Additionally, the notifier implementation checks to see that the size of an accumulated partial state notification is smaller than the full state, and if not, the notifier sends the full state notification instead. The disadvantage is that batching and matching will introduce additional processing delay in the PS. Currently, a subscription refresh is needed in order to update the throttle interval. However, this is highly inefficient, since each refresh automatically generates a (full-state) notification carrying the latest resource state. In addition, with this mechanism the watcher does not have a real-time view of the subscription state information. Moreover, holding the information will require additional buffer space. Nonetheless, this policy may be helpful for IMS terminals with low processing power capabilities, limited battery life or low bandwidth accesses.

4. Compression of SIP messages is another technique to minimize the amount of data sent on low-bandwidth access. RFC 3486, RFC 3320, RFC 3321 defines signalling compression mechanisms. Usually these algorithms substitute words with letters. The compressor builds a dictionary that maps the long expressions to short pointers and sends this dictionary to the de-compressor. However, the frequency of data transmission is not reduced in such techniques.

3.5 IMS Mobility Management

The growing desire of network providers to introduce support for voice over IP has created interesting challenges in the area of interoperability with existing wireless circuit networks. The 3GPP and the 3GPP2 standards have defined the IP Multimedia Subsystem as the platform for convergence. By definition, IMS is access agnostic; it provides services and features through a common core network, regardless of the means of transport. However, the IMS standards are just beginning to address the challenges associated with interworking with existing cellular circuit networks. Achieving seamless mobility involves supporting both roaming and handoff between networks.

3.5.1 IMS Mobility Management in IPv6 Issues

Neumann [70] implemented a prototype and evaluated the performance of a QoS conditionalized handoff scheme for mobile IPv6 networks [62]. The work shows that QoS-enabled handoffs can be achieved with a small amount of introduced latency compared to Hierarchical Mobile IPv6, which is much less than that of Mobile IPv6. Although fewer packets were found to be lost, their scheme needs to interact with an end-to-end QoS signalling solution. Urien [71] proposed a network management protocol by policies with Common Open Policy Services (COPS) for both macro and micro mobility. It seems their architecture solves the mobility in IP network with a soft handover mechanism. However, the protocol needs to be validated to evaluate its performance.

Performance evaluation of network and application layer multicast over MIPv6 networks and IPv6 handover techniques over wireless LAN have been analysed in. Comparison between IP multicast and application layer multicast has been performed by Finney [73] under a specific assumption: end hosts are wireless devices using MIPv6 protocol. Their work suggests that the advantage of using IP multicast grows stronger in mobile networks while the packet loss increases for application layer multicast. Nevertheless, the work was limited within the multicast technique only [54]. The throughput and number of users were varied to get useful insight into the handover behaviors. Fast handover was found to offer shorter disruption times. However, duplicate address detection was not taken into account in their experiment, which might introduce greater disruption time. Also, the test was performed for wireless LAN only.

The IETF mobile IPv6 (MIPv6) enables correspondent nodes (CNs) to directly send packets to a mobile node (MN) using care-of address of the MN. For this service, however, MNs always have to inform CNs and the home agent (HA) of its new location at each movement. To reduce this control signalling, the existing hierarchical scheme built on top of the MIPv6 separates micro-mobility from macro-mobility and exploit an MN's locality. The hierarchical scheme does not achieve real optimization of packet routing. Packets from CN to MN are delivered through an intermediate mobility agent. It brings needless delay on packet delivery and imposes heavy loads on the intermediate mobility agent.

Also, none of the above works emphasizes similar comparison on the session set up issue in MIPv6.

3.5.2 IMS Mobility management in SIP

Considering the fact that mobile IP may not provide fast enough handoffs to support rich data communications, much work observed to performed on other signalling protocols like SIP that may provide a better solution. Location management and handoffs over SIP have been key areas where researchers worked on lately. Investigate mobility support of SIP in different environments. Wedlund and Schulzrine [73] proposed to use mobility support in the application layer protocol SIP where applicable in order to support real-time communication in a more efficient way. In their proposed architecture, a mobile policy table is used for deciding what source address to use (home or care-of address) whether it should be tunneled, or even use a bidirectional tunnel. Moving the mobility handling to the application layer eliminates the need for tunneling of the data stream.

Moreover, the fact that SIP mobility is at the application layer means that it can be installed easily. They also described the traditional hierarchical registration mechanism in SIP (Figure 3-5).

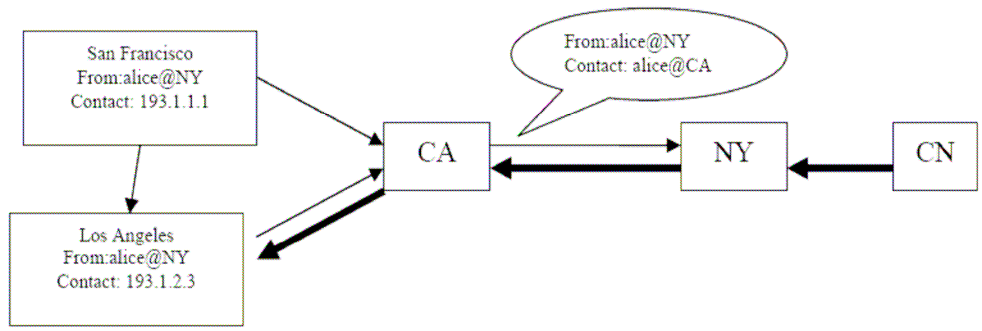

Figure 3-5: Hierarchical registration in SIP [73]

As per discussed in their research work, demonstrating their research diagram [73], Alice with a home in NY, visits CA. Each time she moves, she send 1 REGISTER request towards her home register, through the out bound proxy in CA. For the first REGISTER, originating in San Francisco, the outbound proxy makes a note of the registration and then forwards the request to the normal home register, after modifying the Contact in the registration to point to it rather than Alice's mobile host. After Alice travels to LA, the REGISTER update hits the same register (CA). It recognizes that Alice is already in CA and does not forward the request. A call from anywhere first reaches the NY proxy server, which forwards the request to the CA proxy server, which in turn forwards it to Alice's MH (mobile host).

Moh [74] emphasized the ability of SIP to compare with H.323 in the support of mobile telephony over the Internet addressing the issues of registration in roaming and location management. Much work has been done on the standard QoS part of SIP. IETF working group mainly to support policy control in an IP QoS environment defined COPS protocol.

Salsano and Veltri [75] proposed COPS based model to provide admission control scheme in SIP-based IP telephony applications that can use Diffserv-based QoS network. A test bed implementation of the proposed solution was described. The mechanism can also be used in virtual SIP links. The aim of DRA is twofold. Firstly, it is a methodology to enable the QoS provisioning for the virtual SIP signalling network. Secondly, it achieves the dimensioning automatically on the fly. It uses capabilities that mixed services IP transport networks provide.

Harris and Kist [76] argued that since the DRA methodology allows the automated configuration of resources and ensures QoS for signalling, it enables the guarantee of QoS to customers in UMTS networks. Kueh, Tafazolli and Evans [77] evaluated the performance of SIP-based session set up over satellite Universal Mobile Telecommunications Systems (UMTS).

Similar work needs to be performed in IMS environment. SIP service users and providers require fault tolerance with high service availability and reliability. In order to allow for mid-call fail-over, call states need to be replicated, but this may cause call state inconsistency. The trade-off relationship between SIP transaction inconsistency and read delay exploited to derive the algorithm that is easily adapted by the SIP traffic networks.

Kist and Harris [76] argue to use virtual SIP links to enable QoS provisioning in SIP signalling overlay networks. Their methodology includes the well-known leaky bucket concept to calculate the message loss probabilities. They also introduced a queuing scheme that reduces the required network resources. However, none of the above works proposes to optimize the cost for required resources in the network; neither they include the impacts by DiffServ environment.

3.6 Service management and Charging in IMS

Next-generation communication services will be driven by increasingly rich and distributed subscriber information. Current wireless networks have evolved such that subscriber information now resides in various elements (e.g., home location register [HLR], prepay, voice mail, short message, and location determination systems). Convergence with the Internet promises significantly more personal information, such as presence, calendars, address books, buddy lists, pictures, and video. IMS network aims to serve multiple services to network users; Data management is a big concern for Network management as well as for charging aspect too. [56] Daniel F. Lieuwen, with their team, on Subscriber's data management in IMS Network. Regarding their research the HSS in the IMS architecture provides centralized storage for subscriber data. However, some application servers will also have their own subscriber data.

An efficient IMS online charging system is important for operator revenue generation. A brief specification regarding service management with concern to Charging management in IMS also found in [50] Yigang Cai, Xian Yang Li, Yile Wang, John B. Reid and Peng Wang discuss in-depth IMS online session charging call control. Service charging must performed on the acquired subscriber's service subscription details. This research paper discusses how IMS network elements such as the application server and the serving call session control function (S-CSCF) interact with the online charging server (OCS). They also policy-based IMS call control system that converges the multiple application servers and the IMS gateway functionality into one IMS node for online session charging. The IMS session charging call control system employs a session charging trigger mechanism that enables a real-time report of session information and provides budget control for online quota monitoring of customer. It also enables service logic for multiple applications to be executed in a single node to greatly reduce traffic access between the IMS call session control function (CSCF) and the OCS.

In these brief discussions by researchers, they also specified quantity and variety of applications grow, it will become increasingly useful to provide unified views of subscriber data both within a network and across networks.

Concept for integration new service for specific parameter for charging like IPTV, Triple Play does not discuss in this research work, then also majority of data subscriber's management term briefly discussed here.

3.7 IMS Client

Flexible and extensible code base for researchers and industry specialists to use the many communication services offered by the IMS, as from 2006 the client has grown, both in terms of its stability and its feature set, and is used worldwide by IMS enthusiasts as a means to experiment with IMS without any associated risks or costs.

Among all the IMS components, the IMS User Equipment (UE) is a critical entity for the overall success in the IMS value chain. This is because, the UE is the only component that demonstrates IMS services found on the network, and the presentation of these services to the end-user will determine the return on investments on IMS. Early IMS service demonstrations are standalone solutions or support a limited set of basic services such as Voice over IP (VoIP), Presence and Messaging with little or no room for extensibility or reusability. IMS Client one of the major research focuses to enhancing extended value added services.

David Waiting, Richard Good, Richard Spiers, Neco Ventura has implemented UCT IMS Client [127], depicting an open source enable IMS approach for the NGN. The UCT IMS Client is a free open source implementation of a 3GPP IMS Client. This research work discusses software architecture, and the supported services and provides results of the various interoperability tests that have been performed between the UCT IMS Client and other freely available IMS Clients [127].

Widely adapted heterogeneous network architecture not discussed with this research as well the concept of service provision and service integration not taken with much in-depth of this work, but IMS Client concept to implementation with key technique is important in this research. With this work they have analyze and report activities to develop an IMS client framework that provides intrinsic IMS functionalities and supports reusability, service composition/aggregation for seamless user experience, extensibility and dynamic service provisioning.

Vignesh karthik M, Shadangi Prateek have implemented IMS Client using Open source tools in [78]. They have used open source elements like OpenIMSCore, OpenIKEv2, Strongswan, Open Sigcomp and SIPp to build an IMS client test bed. They also discusses a test bed that can be used to test an IMS client across various use cases that include simple 3GPP call flow, call flow with signaling compression, call flow over TLS, call flow with security and a call flow from a device behind NAT with STUN server. All test bed in this project is built to accommodate IMS clients operating on varied access types like LAN, GPRS/EDGE/UMTS and Wi-Fi.

From these research observations, erudite that 3GPP IMS standards are evolving and the client side requirements bulge every month. It is important to ensure an IMS client is tested during the time of development with a platform that simulates the IMS network. As it is an expensive preposition to rely on operators live network for testing and a live network cannot simulate error conditions, an IMS Client test bed becomes essential.

3.8 IMS QoS, QoE Approach

Services provided in Next Generation Network must provide guaranteed quality end-to-end. This is quite a challenging issue since the fluctuation of network conditions is large in a Fixed Mobile Convergence network. Therefore, a novel approach where a network node and a mobile terminal such as a cellular phone cooperate with each other to control the service quality is essential. With [79], [80] researchers presents in-depth study and results for providing best QoS and QoE over IMS enable NGN network. The service quality measured by a cellular phone can be used as a trigger to activate the resource and admission control function of the network node.

With [79] work on including the function of the IMIN architecture in order to enlarge IMS services guaranteeing e2e services quality. This work had suggested the Framework for IMS Interworking Networks with e2e (End to End) Quality of Service Guarantee. They consist of an IMIN Server to parse, decide and transmit signal/bearer traffics and an IMIN Resource Manager to collect, forward and manage QoS information. They also discussed the function of each component in an IMIN Server. It is essential to consider it to improve and guarantee e2e QoS in IMS interworking through IP backbones because the existing IP interworking architecture doesn't support e2e QoS. Finally highlighted the call flows for the IMIN architecture to process the sip message and media traffic based on SLAs.

The IP Multimedia Subsystem (IMS) could very well be the best solution for most telecom operators. The more recent releases have included interfaces to fixed line networks and Wireless LANs. This has consequences both for the migration of the core network as well as the integration of future mobile services and applications. Also, an interworking between IMS providers is considered to be a major step toward End-to-End IMS services and IPX (IP Interworking Exchanged) networks are introduced as the requirement to support QoS features in GSMA. But these architectures don't specify any requirements for e2e QoS through IPX networks. This purpose of this article is to research of IMS interworking Network for enlarging IMS services guaranteeing e2e services quality and suggest the IMIN (IMS Interworking Network) framework to guarantee IMS high quality end-to-end services.

Another research in [80] a QoS/QoE measurement system implemented on a cellular phone. With this implementing the QoS/QoE measurement system, they had measure a user's perceptual quality as well as the network conditions in real-time. As for the method of measuring the user's perceptual quality, they had proposed an objective speech quality estimation method that is applicable to a cellular phone with poor computational ability. In spite of the simple algorithm, experimental results show that their proposed method can estimate the speech quality with high accuracy regardless of the codec type.

3.9 Innovation application with IMS

IMS Network able to integrate more and more innovative service over their own platform as well as provision covering User Equipments as well. With [81] Inka Koskela, Ilkka Arminen discusses one of the most attractive application for future called Mobile Blogging. Blog is common term for make people update for one's own activities, interest. Basically Blog created for a purpose to share with all. Make thing publicly known, with GPRS integration with Mobile Phones that is too easy to access blog through UEs like Mobile phone. But in the research [81] Mobile based blogging service with respective aspects of attractiveness and responsiveness of its all are discuss in brief. That's no doubt Blog will remain need of people, but Moblog will definitely take place of Internet based Blog cause of light-weight nature of working easy access and uploading sharing. Although ubiquitous nature supported by IMS is also big concern.

Another research [82] Funitoshi Kato and Aiko Shimizu briefly discusses application of MoBlogging in form of Face-work at Corporate world. Community MoBlogging used for particular group form and share among members, with this research discussion they also demonstrate some of the community as well as corporate world aspect of sharing resources among present members of blog. With Moblog the an on hand sharing service easily enabled and able to share any resource including voice, video, text any time to any where over IMS Networks.

3.10 Discussion of Problems based on Literature Review

There are several aspects in the IMS that require much attention and modifications. Some of the existing technologies are still underdeveloped. A few problem areas have been identified as part of this research work. The literature review discussed thus far strengthens the niche for these statements of problems stated below.

3.10.1 Aspect 1: IMS Client

With IMS client user able to enter IMS Network and access services provided through Network. With this literature survey Research direction able to find already existing IMS clients [125], [127] able to enrich high to high level of service, but nature of IMS Network always expanding and providing more and more service. With the concept this research firstly propose own IMS client in term of low size and capability to deliver all Java enable service over its own platform.

Although for designing and deploying IMS client over IMS test bed during research J2ME language choose as work out on this. This first aspect considering to create an IMS client which able to render all service over selected Open IMS Core test bed, even if Open IMS core having own Client, but service rendering tools and such other resource limitation make this work to workout own Client for IMS Services.

3.10.2 Aspect 2: Presence Service

Presence service is the foundation service among other services in the 3G IMS. Scalability is always an issue for massive number of watchers / presentities joining an IMS cell. The message-processing load will be heavy for presentity movement. Every time presentities change state, messages will be generated to the PS and consequently the PS will update the corresponding watchers. This will have direct impact on the performance of a PS. A presence application in an IMS mobile terminal device contains a list of 100 presentities. A watcher receives NotifyPresUp message every time any of its presentity changes state. Although the SIP (Session Initiation Protocol) event notification framework (RFC 3265) offers powerful tool, in some situations the amount of information that the Presence Server has to process might be large. When presence information reaches a small device that has constraints in memory, processing capabilities, battery lifetime and available bandwidth, the device may be overwhelmed by the large amount of information and might not be able to acquire or process in real time. So, there has to be tradeoffs between the amounts of information sent, the frequency of the notifications, and the bandwidth usage to send that information.

Methods to mitigate the message-processing load from the PS with the balance in the real time view of the watcher notification are essential. In order to achieve this, efficient scheduling and reduction in bandwidth consumption in the admission control of a PS is required. There exist some mobile node presence optimization techniques like Partial Notification mechanism, Event Filtering etc,. However, these are still under design phase of the IETF and a stable solution is under developed and required. Deriving efficient admission control mechanisms for a Presence server is under the scope of this research. The IMS terminal subscription/registration time is another key issue while a mobile node registers with its home network Presence Agent / Presence Server as a watcher.

The existing procedure in IMS allows a mobile node to publish its presence as a watcher to its Presence Agent (PA) either for a constant amount of time or for a period of time mentioned by watcher during the time of publishing. If the registration/publishing time is set too short compared to the mobility of the IMS mobile node, the mobile node will have to re-publish its presence soon with the same PS. The frequency of sending messages for such implicit registration/subscription will be increased. Thus the re-registration with the same information will introduce extra messages and redundant data in the cache. On the other hand, if the registration time is set too large and the mobile node does not re-register with the home network until the time out occurs, the actual position of the node becomes unavailable for the home network. This will lead packets to deliver from MN to CN inefficiently.

Again, excessive de-registration may introduce overheads in number of messages. Another problem of having the publishing time of a watcher node too long in IMS is that the system will have to periodically notify the watcher the information of the presentities (it is watching). Any location update at the presentity side will result in notification to the watcher by the system. So, the constant time set may create bottleneck because of excessive message flow in the network. In other words, for a long timed extension, a PS will have to generate excessive NotifyPresUp messages to keep the watcher updated, where as for a short one, the watcher will have to subscribe frequently with the PS and accordingly increasing message flows in both cases. Thus an optimal procedure to set the timer of the registration/subscription life time for the mobile node with its home network in IMS is desirable.

3.10.3 Aspect 2: IM Service

For users, IMS-based services enable person-to-person and person-to-content communications in a variety of modes – including voice, text, pictures and video, or any combination of these – in a highly personalized and controlled way. IMS enables the efficient creation and delivery of an exciting range of emerging multimedia services that can be delivered over mobile, fixed, or converged mobile and fixed networks. Today's telephony and messaging services will be complemented by the next-generation of user-to-user applications.

In any IMS network the capacity is large for Instant Messaging (IM) communication service. Large messages have to be broken down into chunks to overcome the fixed size limit fact. Real time service of IM is always desirable. However, issues arise if the relay nodes in between source and destination IMS terminals possess slow links with finite buffer. Therefore analyzing service discipline of the chunks of IM is necessary. In an IM system with relay nodes, the buffer capacity and the service rate of the relay nodes may vary. Analysis of such system is not trivial.

In this thesis, a brief studying of Instant Messaging endurance over Open IMS Core Test Bed analyzed. Such analysis of IMS instant messages indeed requires much attention when the capacity and the service time of the relay nodes vary. As this study for fundamental framework as well service enhancement phase is also discussed well with conception of integration and differentiated service over the same network with various User Equipments.

Proposed research step up towards service provision including service delivery platform creation and observe service rendering over Test Bed for IMPS over Open IMS Core network.

3.10.4 Aspect 4: IMS based Mobile Blogs

IMS Service deployment and delivery support always encourage user to create more and more service. Although IMS 2.0 able to work with Web 2.0 over IMS Network. During research survey phase, new innovative service needed to deploy for observe IMS open service provision nature, with the conception there are lot more application observed including Location based services, Games, Network Games as well. But finally Mobile based blogging selected for considering IMS Service provision and rendering over User equipment phase.

The MoBlog does not automatically support either self-presentation or intercommunication of the participants. Instead suggest that functions of the MoBlog alter situational while participants engage themselves in different ways and levels to the participative actions and processes of the MoBlog. The participants simultaneously manage multiple ways of being present and display multiple levels of presence within practices of distributing pictures, seeing them or interacting by writing of them. In what follows suggest that MoBlog may serve as a tool for storing, publishing, sharing or communication or all of those together depending on the situational varying activities in which participants actively engage themselves.

With a simple aim to make prototype application for IMS MoBlog service aim to create with J2ME and supportive tools and planning to deploy over own IMS light size Client through provision of this MoBlog through Open IMS Core Test bed setup.

Through this application, ubiquitous nature of IMS Network as well as service support including new service provision, load balancing, and some other aspect of Charging and User profile management all seems to be observe through simple MoBlog application deployment over through Open IMS Core Test bed. Some relevance observation including latency, user profile management as well as charging needs to work directly over IMS HSS, because all relevant tasks placed over there, while for deploying new application MRFC able to support new services' server level technical support and pass through IMS HSS and Core nodes to observe service rendering over existing network.