Guidelines for Adoption of IP Multimedia Subsystem (IMS)

(SKMM/G/04/09)

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Notice:

The information contained in this document is intended as a guide only. For this reason it should not be relied on as legal advice or regarded as a substitute for legal advice in individual cases. Parties should still refer to the legislative provisions contained in the law.

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Committee Representation

This guideline has been developed in collaboration with the Malaysian Technical Standards Forum Berhad (MTSFB). It is intended to provide a guideline on adoption of IP Multimedia Subsystem (IMS) for the industry in Malaysia.

This Guideline was developed by the Working Group (WG) on Next Generation Network (NGN) / IP Multimedia Subsystem (IMS) of the MTSFB. The working group consists of the following organizations (in alphabetical order):

- Alcatel-Lucent Malaysia Sdn Bhd
- BT Multimedia (Malaysia) Sdn Bhd
- Celcom (M) Berhad
- DiGi Telecommunications Sdn Bhd
- Ericsson (Malaysia) Sdn Bhd
- Maxis Communications Bhd
- MIMOS Berhad
- Orbitage Sdn Bhd
- Telekom Malaysia Berhad
- ZTE (Malaysia) Corporation Sdn Bhd

This guideline should be read together with the CMA, the relevant subsidiary legislations, instruments, codes and guidelines that have been issued by the MCMC pursuant to the CMA.

Compliance with this Guideline does not itself confer immunity from legal obligations.

Executive Summary

This document is presented as a guideline to Malaysian Telcos, Service Providers and other interested parties when considering the adoption of the IMS.

The IP Multimedia Subsystem (IMS) is a network domain designed to support the control of multimedia sessions over IP networks. It was initially developed as part of the UMTS roadmap by the 3rd Generation Partnership Project (3GPP) being introduced in Release 5 but with substantial enhancements in subsequent releases. Today, IMS has been adopted by major operators as a service platform well beyond mobile networks and has been expanded to become agnostic of access technology.

The key extensions have been for fixed line access through TISPAN (Telecoms and Internet converged Services and Protocols for Advanced Networks) and for the cable TV industry through CableLabs Packet Cable standard. It is also being proposed for use in WiMAX networks and as a platform for corporate Intranet/Extranet services such as unified messaging. It is envisaged that IMS will be at the heart of all networks providing a converged platform for seamless interoperability, roaming and billing. As such this document proposes IMS guideline to be based on TISPAN Release 1 and 3GPP Release 6 as a baseline.

Key control functions provided by the IMS include:

- End to End QoS negotiation
- Security management
- Seamless service management in a converged landscape
- Session based accounting and billing

The importance of the IMS is that it decouples services from the network infrastructure, providing a framework in which the development and delivery of services is simplified. Application developers need only communicate with the IMS, abstracting them from the intricacies of the network technology as well as allowing them to leverage on the various service enablers deployed in conjunction with the IMS to further enhance their service.

These may include presence and location services, content personalization, to name but a few. It is also in this service enabler area that there is much opportunity to develop IPR and be at the forefront of this fast growing convergence industry.

This presents opportunities where applications and services can be deployed more rapidly thus reducing time to market, and can be personalized and customized for smaller target groups. This places the operator heavily in the value chain as a service provider with a ready pool of developer talent available to meet the needs of the market.

Highlighted below are the critical areas that will contribute to a successful IMS implementation:

- Wide availability of support for IMS services in client / terminal devices at an affordable cost
- User friendly IMS clients
- Content development community
- Rich IMS applications and services

- End to End Quality of Service to support real time applications
- Seamless mobility and roaming support for applications and services

Noted that to achieve rich service functionality, current IMS clients tend to work better when the client and IMS network is provided by the same vendor thus limiting interoperability between different vendors. This is understandable since IMS is complex and in its infancy however we would expect much interoperability testing to take place as more content and application developers come online.

It should be noted that the IMS is a control platform and application data is carried over the providers IP backbone. To realize inter operator IMS services the IP interconnection needs to be in place between operators nationally and internationally. It is recommended that the regulator would review the existing interconnection frameworks to better support IMS.

The purpose of this document is to outline the MTSFB NGN WG's recommendations on IMS guideline in Malaysia. This will include:

- Minimum standards for IMS implementation
- Dependencies for IMS in Malaysia
- Key success factors
- Challenges ahead
- IMS architecture and ecosystem

This document is a living document, which reflects the current state of IMS and as such should be reviewed periodically if and when there is new development made by standards bodies and other relevant parties.

1. Introduction

IMS opens a new era for the telecom industry by enabling new business opportunities and revenue streams in light of shrinking ARPUs for traditional voice services. The IMS architecture provides an underlying framework enabling operators and application developers to roll out new services more efficiently and seamlessly across multiple access networks. It is assumed that most service providers will be deploying the IMS to facilitate new applications and services however the lack of innovative IMS applications is a major inhibitor to its adoption. Likewise, many application developers are not currently developing IMS solutions due to a lack of awareness and commercial deployments. This presents an exciting opportunity for Malaysian developers to lead the way in this emerging and lucrative market.

The IMS creates a unified service control platform to manage seamless transmission of services across different networks. IMS provides customers with a dynamic, personalized user experience presenting numerous enhancements to their existing service portfolio including service roaming and interoperability across multiple networks, single sign on as well as user friendly and cost effective access to rich applications and content. In many cases it will be possible to defray costs to users with the incorporation of smart, directed advertising embedded into the services.

The IMS is the enabling platform for what is more generally referred to across the communications industry as Next Generation Networks (NGN). It is anticipated that we are moving into an era where rather than having separate networks providing us with overlapping services, it is the relationship between the user and service that is important and the infrastructure will maintain and manage this relationship regardless of technology. The most obvious overlap currently is between fixed and mobile networks, and the IMS has been identified as a platform to support their convergence through what is known as Fixed Mobile Convergence (FMC).

The Third Generation Partnership Project (3GPP), which primarily focuses on the needs of mobile operators, has led the effort to develop and standardize the IMS in an open framework. 3GPP now works very closely with ETSI TISPAN to define a harmonized IMS centric core for both wireless and fixed line networks. Central to the IMS is the Internet Protocol (IP) and its suite of related protocols, most notably SIP (Session Initiation Protocol) for real time session control. 3GPP have taken IP protocols as is from the standards developed under the Internet Engineering Task Force (IETF) and have worked closely with them to extend them where needed. Other standard bodies have adopted most core IMS functions for their respective domains and have developed relevant segment specific IMS extensions for next generation mobile, wire line, and cable services, as shown in Table 1 below.

Standards Organization	Scope/Focus	Standards Contribution
Internet Engineering Task Force (IETF)	All IP networks	SIP and other protocols (e.g. SDP, RTP, DIAMETER, etc.)
Third Generation Partnership Project (3GPP)	UMTS WCDMA mobile networks and other access networks	IMS
Third Generation Partnership Project 2 (3GPP2)	CDMA 2000 mobile networks and other access networks	Multimedia Domain (MMD)

Standards Organization	Scope/Focus	Standards Contribution
European Telecom Standards Institute (ETSI)	Next Generation wire line networks	NGN effort by TISPAN
International Telecommunication Union (ITU-T)	Next generation wire line networks	Focus Group on Next Generation Networks (FG-NGN) and other ITU-T study groups
CableLabs	Cable IP networks	Packet Cable 2.0 project

Table 1: Standards organizations and their IMS contributions

IMS has evolved from providing only mobile wireless access (as per 3GPP Release 5) to be access agnostic, and it now takes advantage of multiple access technologies including WiFi, Worldwide Interoperability for Microwave Access (WiMAX), Digital Subscriber Line (DSL) and broadband cable as per 3GPP Releases 6, 7 and TISPAN 1. This access independence essentially makes the IMS future proof and means that implementation and evolution of access technologies such as 3GPP LTE and LTE Advanced will still be supported.

2. Scope and Objectives

The objective of this document is to provide a guideline on adoption of IP Multimedia Subsystem (IMS) for the industry. The document addresses the following:

- IMS standard releases and baseline implementation recommendations
- Dependencies in implementing IMS
- IMS architecture and features
- Minimum functional IMS components required to deploy IMS systems
- Recommended complementary systems
- Key success factors and challenges

Please note that the scope of this document is based around these objectives and does not include IMS commercial aspects, test planning for interoperability between operators and vendors or interconnectivity requirements.

3. IMS Standardization Overview

IMS is currently being standardised by the 3rd Generation Partnership Project (3GPP, www.3gpp.org) beginning with Release 5. Releases up to Release 8 are now frozen, with the current work being extended through Release 9 and 10.

The IMS is also being used as a platform for Fixed Mobile Convergence (FMC), with work here being done by TISPAN, as well as the WiMAX Forum for use with the IEEE 802.16e standard (better known as Mobile WiMAX) as a platform to manage the delivery and billing of real time services. In addition, the ITU-T has based their NGN work on the IMS, and the IMS has been adopted by CableLabs, a global consortium of cable television companies.

IMS is based around open standards and reuses IETF IP protocols for session control and security procedures, in particular:

- Session Initiation Protocol (SIP): Session control
- DIAMETER: security, authorization and accounting control

A client device communicates with the IMS using an IP based packet switched access network, for example via the GPRS/UMTS Packet Core GGSN, however from 3GPP Release 6 onwards its use is not confined to 3GPP mobile networks. Key to the adoption of the IMS is its use of open standards to allow for seamless interconnectivity between devices, networks and services.

Each operator's IMS platform can be connected to other operator's IMS platform over an IP backbone, allowing multimedia service roaming and also supports interoperability between users on different networks.

4. IMS Architecture

Figure 1 shows a functional diagram of the IMS with its core elements to provide IMS services. Please note that only control paths are shown.

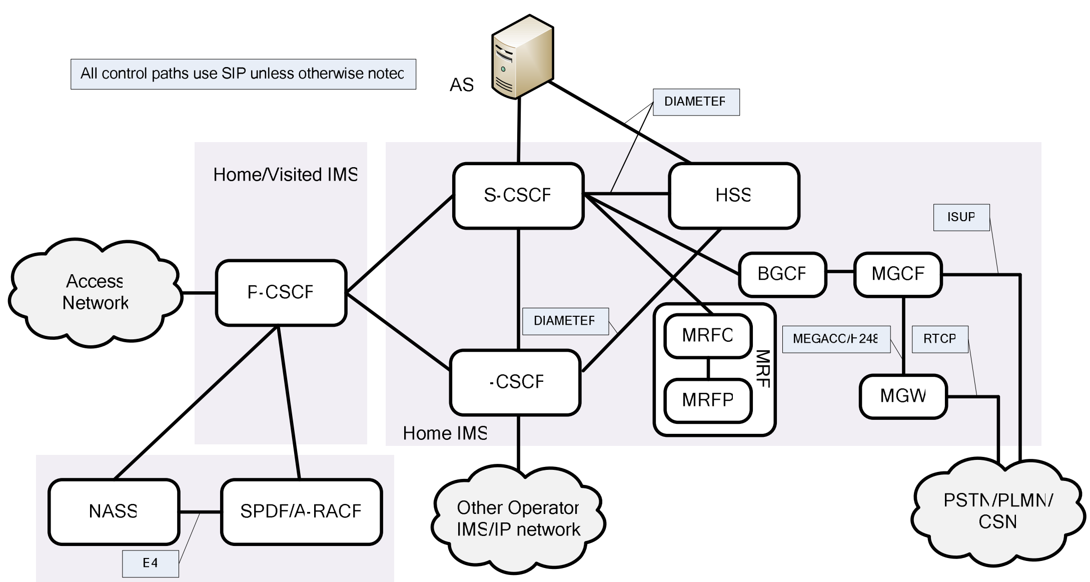

Figure 1 : IMS functional diagram

4.1 Components of IMS Platform

The IMS is made up of a number of component parts connected together using an IP backbone.

Each mobile user must first obtain an access network connection to the IMS prior to using its services, which generally means authentication/registration is done twice, first for the access network and then for IMS. The client device always connects to the IMS via the P-CSCF, which may reside at the user's home network, or in a roaming scenario within a visited network.

On the right hand side of the figure can be seen the connection to external circuit switch networks via the MGW and MGCF (soft switch). The application server provides IMS value added services. This could be for example a presence server, content server (video on demand) or interactive voice/video mailbox server.

4.1.1 Call Session Control Function (CSCF)

Data transfer between users of the IMS is organized into sessions. The CSCF is responsible for session control and is the control point for the following functions:

- User authentication
- Call routing
- Establishing QoS over the access network
- Control the generation of Charging Data Records (CDRs) for accounting purposes

All call/session control signaling in the IMS is performed using the Session Initiation Protocol (SIP). Three types of CSCF are defined: P-CSCF, S-CSCF and I-CSCF.

4.1.2 Proxy CSCF (P-CSCF)

This acts as the first point of contact for call signaling coming from the client device. The P-CSCF forwards the call signaling to the Serving CSCF, which is the home network's point of control for the call. For a roaming subscriber, the P-CSCF will be located in the visited network. The P-CSCF is also responsible for controlling the generation of CDRs (Charging Data Records) for mobile originated calls.

4.1.3 Serving CSCF (S-CSCF)

This carries out the call/session and accounting control for a given subscriber. The S-CSCF is always located within the subscriber's home network. This means that all mobile originated call signaling is routed via the user's home network. This non optimal routing covers only signaling traffic, call traffic is still forwarded using standard IP routing between the access networks.

4.1.4 Interrogating CSCF (I-CSCF)

The I-CSCF acts as a point of entry for SIP signaling coming from outside the operator's network. This signaling could be:

- a SIP call set up request destined to a subscriber of the operator's network
- a SIP call set up request destined to a roaming subscriber within the operator's network
- a registration request

For incoming registration requests the I-CSCF is responsible for assigning a S-CSCF to the subscriber. The choice of S-CSCF can be made dependent on the identity of the subscriber (SIP address or IMSI), handled on load sharing basis or using a main server, backup server arrangement.

4.1.5 Application Server (AS)

This provides value added services to a subscriber. This could be anything from receiving streaming video service (video on demand) to providing voice and video mail services. Application servers are key to service provision in the IMS to extend the functionality of services with enabling applications such as presence, subscriber management, location, etc. The AS should be able to generate CDR for service accounting purpose.

4.1.6 Breakout Gateway Control Function (BGCF)

This is used to select the appropriate gateway to forward call destined for legacy networks such as the PSTN. A S-CSCF will forward all connection requests with destinations in these legacy networks to the BGCF, which will then forward them to the appropriate MGCF.

4.1.7 Multimedia Resource Function (MRF)

The MRF is made up of two components, the MRF control and MRF processor and is responsible for providing functions such as:

- Mixing media for video/voice conferencing (conferencing bridge)
- Providing multimedia announcements
- Processing media streams, e.g. audio trans-coding

The MRF functionality is split into a control (MRFC) and a media processing part (MRFP) in much the same way as functionality is split between media gateway controller and media gateway. The interface between the two components is controlled using the H.248/ Megaco protocol. The MRFC receives call control signaling via the SIP protocol (e.g. to establish a video conference between a number of parties).

4.1.8 Media Gateway Control Function and Media Gateway (MGCF and MGW)

The media gateway control functionality and media gateway provide a connection between the IMS and external circuit switched networks such as ISDN or GSM. The MGCF controls the MGW and interfaces to the S-SCSF using the SIP protocol. Call signaling (e.g. SS7/ISUP) is forwarded from the circuit switched network's signaling gateway to the MGCF using Sigtran. The MGCF must translate messages between SIP and SS7/ISUP to provide inter-working between the two protocols. Control signaling is to the MGCF whereas actual data flow is to the MGW.

4.1.9 Home Subscriber Server (HSS)

The HSS contains a master database of all the subscribers on the network and contains the following information:

- Identification information (user's telephone number, SIP addresses, IMSI)
- Security information (secret authentication keys)
- Location information (current serving access network, IP address)
- User profile information (subscribed services)

It also is responsible for generating security information such as authentication challenges and integrity and ciphering keys. The HSS may eventually merge with the

HLR/AuC functionality of the cellular networks, which would potentially offer the benefit of a single sign-on for multiple services.

The HSS should be able to provide dynamic subscriber location information update automatically when subscribers normalize and be able to provide NASS-Bundle Authentication (NBA) mechanism for fixed subscriber without username and password.

5. IMS Standard Releases

The 3rd Generation Partnership Project (3GPP) (www.3gpp.org) organization's specification Release 5 introduced the first iteration of IMS functionality providing backward compatibility with the existing circuit based voice and data networks.

Additional features were included in Release 6, such as presence and conferencing. Release 7 extends the IMS with further support for fixed access networks. Also included is the Voice Call Continuity (VCC) standard which offers seamless interoperability (e.g. handover support) between different access networks using the IMS as an anchor.

The evolution of the IMS is further influenced by a number of other standards bodies and interest groups. The key ones are:

- IETF (Internet Engineering Task Force – (www.ieft.org)
- 3GPP2 (3rd Generation Partnership Project 2 – (www.3gpp2.org)
- Open mobile Alliance OMA – (www.openmobilealliance.com)
- ETSI TISPAN – (www.etsi.org/tispan/)
- ITU-T – (www.itu.int)
- CableLabs – (www.cablelabs.com)

The Working Group will endeavor to keep abreast of the latest IMS release and trends so as to appropriately advise the developer community and the wider industry as to the impact, implications and opportunities presented by these developments. This can be done through liaison with external parties to prepare briefs and provide presentations.

5.1 IMS in 3GPP Release 5

3GPP Release 5 defines IMS Phase 1 and the IMS functionality is specifically designed for the 3GPP radio access network. Release 5 Key Functions covered are:

- Provisioning of IP based multimedia services
- Call control and roaming to support IMS in UTRAN
- Access Security for IMS
- Security of SIP signaling between network nodes
- Lawful interception
- Charging and OAM
- IMS to CS inter-working (basic aspects, other ones addressed in later release)
- CAMEL in IMS
- Inter-working between IMS and IP networks

- Inter-working between IMS and CS (Circuit Switched) networks

5.2 IMS in 3GPP Release 6

Release 6 defines IMS Phase 2, where the IMS is generalized and made independent of the access network. Release 6 Key Functions covered are:

- IMS Conferencing
- IMS Group Management
- IMS Messaging
- Inter-working with WLAN
- IMS flow based charging
- Improvements in QoS
- Presence service

5.3 IMS in 3GPP Release 7 and 8

Release 7 & 8 define IMS Phase 3/4. The key functions covered are:

Release 7

- Fixed broadband access to IMS
- Emergency call support
- End to end QoS
- Policy control evolution & charging
- Voice call continuity (VCC)

Release 8

- Multimedia telephony and supplementary services
- Multimedia interworking between IMS and CS networks
- System enhancements for corporate network access
- Security enhancements

Please refer to www.3GPP.org for detailed features of each 3GPP standard release.

5.4 TISPAN Release 1

The TISPAN Release 1 specification was published in December 2005 and its architecture is based on the 3GPP IMS Release 6 architecture but is specifically intended to address the wire line providers. The architecture is modular with open interfaces between modules thus supporting the addition of new subsystems to cover new demands and service classes. It also ensures that the network resources, applications, and user equipment are standardized thereby ensuring user, terminal, and service mobility to the fullest extent possible.

TISPAN is now working on Release 2, with a focus on enhanced mobility, new services and content delivery with improved security and network management.

The functional architecture is structured in two layers, the transport layer and the service layer.

- The transport layer provides IP connectivity to the user. The functionality supported by this layer is divided in two sub-layers: a transport control sub-layer and a transfer sub-layer. The transport control sub-layer comprises the Resource and Admission Control Subsystem (RACS) and The Network Attachment Subsystem (NASS) which are explained later

- The service layer comprises a set of subsystems that provide service control functionalities. The following service control subsystems have been included in TISPAN NGN Release 1: the Core IMS, the PSTN/ISDN Emulation Subsystem, the Streaming Subsystem and the Content Broadcasting Subsystem.

Key functions of TISPAN Release 1 include:

- Support for SIP based and non SIP based applications
- Access agnosticism
- Support for complex commercial models
- Roadmap to fixed/mobile convergence based on IMS
- Reuse of existing standards and collaboration with standards development organization

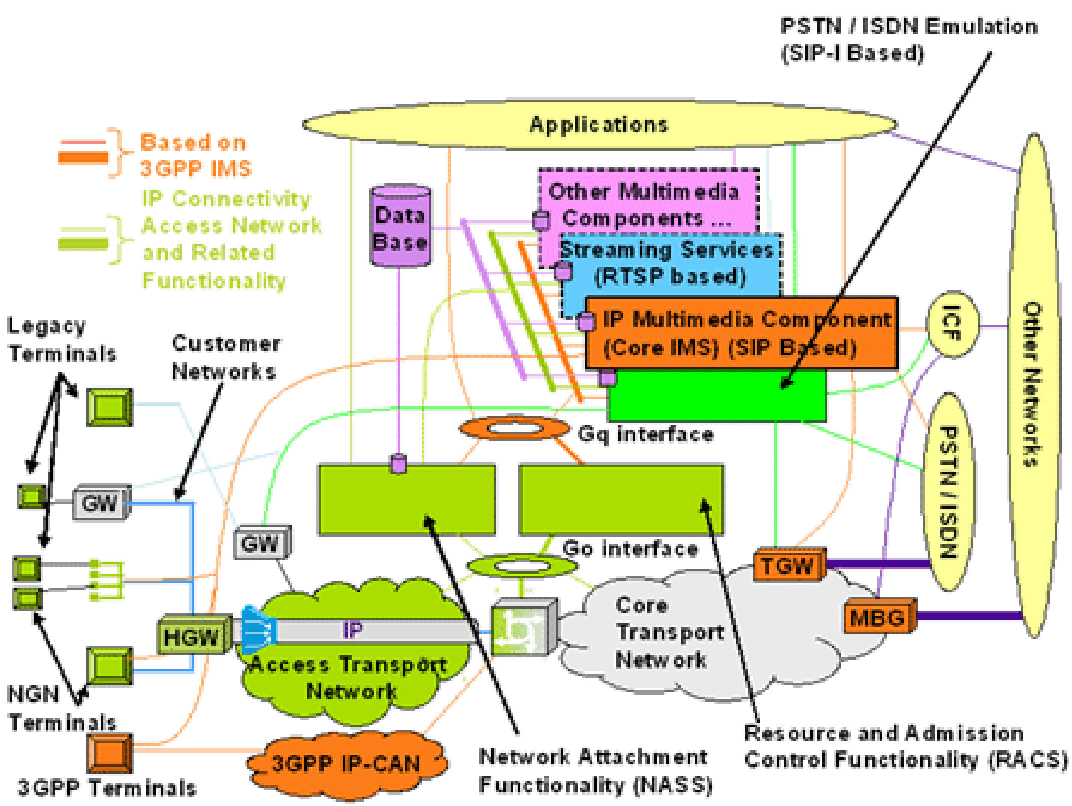

Figure 2: High level view of the overall TISPAN architecture *(Source: ETSI)*

Figure 2 shows a high level view of the overall TISPAN NGN architecture. At the top is the applications domain, which houses the external services.

Underneath are a number of reusable service subsystems that underpin those applications and enable them to be delivered. These subsystems include RTSP based streaming services, the IMS SIP based services, and PSTN emulation services. A key feature is that all these services are linked to a common database, which means that they all share subscriber identity, security and profile information. Services also share two of the most important functional blocks of TISPAN: the NASS and the RACS.

The Network Attachment Subsystem (NASS) provides user registration and initialization for access to TISPAN NGN services. NASS provides network level identification and authentication, manages the IP address space of the access network, and authenticates access sessions. NASS also announces the contact point of the TISPAN NGN service/ applications sub-systems to the user. NASS should be able to provide DHCP service and distribute contact points of IMS to CPE.

The Resource and Admission Control Subsystem (RACS) provides applications with a mechanism to request and reserve resources from the access and aggregation networks. To achieve this, real time multimedia services must be able to trigger the QOS resource reservation, admission control, and policy control capabilities of the network. RACS provides the means for an operator to enforce admission control and set the respective bearer service policies.

A major driver for TISPAN is PSTN emulation, given the huge PSTN user base. PSTN/ISDN emulation mimics a PSTN/ISDN network from the point of view of legacy terminals (analog or ISDN) by an IP network accessed through a gateway. The goal is that the PSTN/ISDN services remain available and consistent so that end users are unaware that they are not connected to a conventional TDM based PSTN/ISDN.

6. IMS Features

There are several available features that are recommended for IMS adoption in Malaysia. Not all of these are yet fully standardized and as such may limit IMS as a full replacement for existing telephony services. However, the reality is that in the short to medium term, the introduction of IMS will be as a parallel system to the existing networks, primarily as a platform for provision of new/evolved services and service/technology integration rather than as a replacement for legacy networks. Particularly with reference to the mobile operators, there will still be considerable revenue streams from roaming business to legacy networks.

Other services that will form a requirement from a regulatory perspective are lawful interception and network security, which are well addressed in the specifications. It is also probable that at some stage the regulator will follow those in Europe and US and mandate that location based services (LBS) be integrated into at least the emergency call support. It is anticipated that most operators will have a roadmap to include LBS for enhancement of service offerings.

It is recommended to include key service enablers as application servers to the IMS platform to provide a rich service creation environment. The most important of these are:

- Presence services
- Document management system for directory services

- Application services for programming environment (Java based, Parlay/ Parlay-X Web services)
- Content management system
- Media services

Another service that is important to the operator is Voice Call Continuity (VCC), which has the potential to allow for seamless, technology agnostic handover between multiple access networks. Currently the specification of this service is limited in scope focusing on only a limited number of technologies and only voice services. To reach its full potential it must be expanded to encompass a full service portfolio through a standardized approach. Currently several vendors have addressed this gap in standardization with proprietary solutions which can lead to problems in the future when operating in a multi vendor environment.

The HSS should be able to provide location information to Application Server, such as emergency call center, through Sh interface to the Application Server.

IMS system should be able to handle Emergency call in higher priority than normal call. During full load, the system should be able to provide Emergency call service.

IMS system should be able to lawfully intercept all calls from/to IMS system.

7. IMS Device and Client Considerations

For the user, the mobile device is potentially the most important element of the IMS service as it is the client for the delivery of various new and exciting multimedia applications. This concept is embodied in the 3GPP term for the mobile device as ‘user equipment’.

In order to support IMS services, the two essential elements that the IMS devices need to have are:

- The appropriate protocol support for IP packet sessions
- Suitably powerful and open platform for client application support

Major application areas that lend themselves to the IMS terminal are Voice over IP (VoIP), Instant Messaging (IM), Push to Talk over Cellular (PoC), Group Management (GM), Presence Service (PS), Dynamic Address Book (DAB) and Voice Call Continuity (VCC). However it is the developer community that will spur the growth of content and applications by utilization of the IMS to create new and exciting applications, thus enhancing business opportunities.

Figure 3 below shows an example of terminal software system architecture.

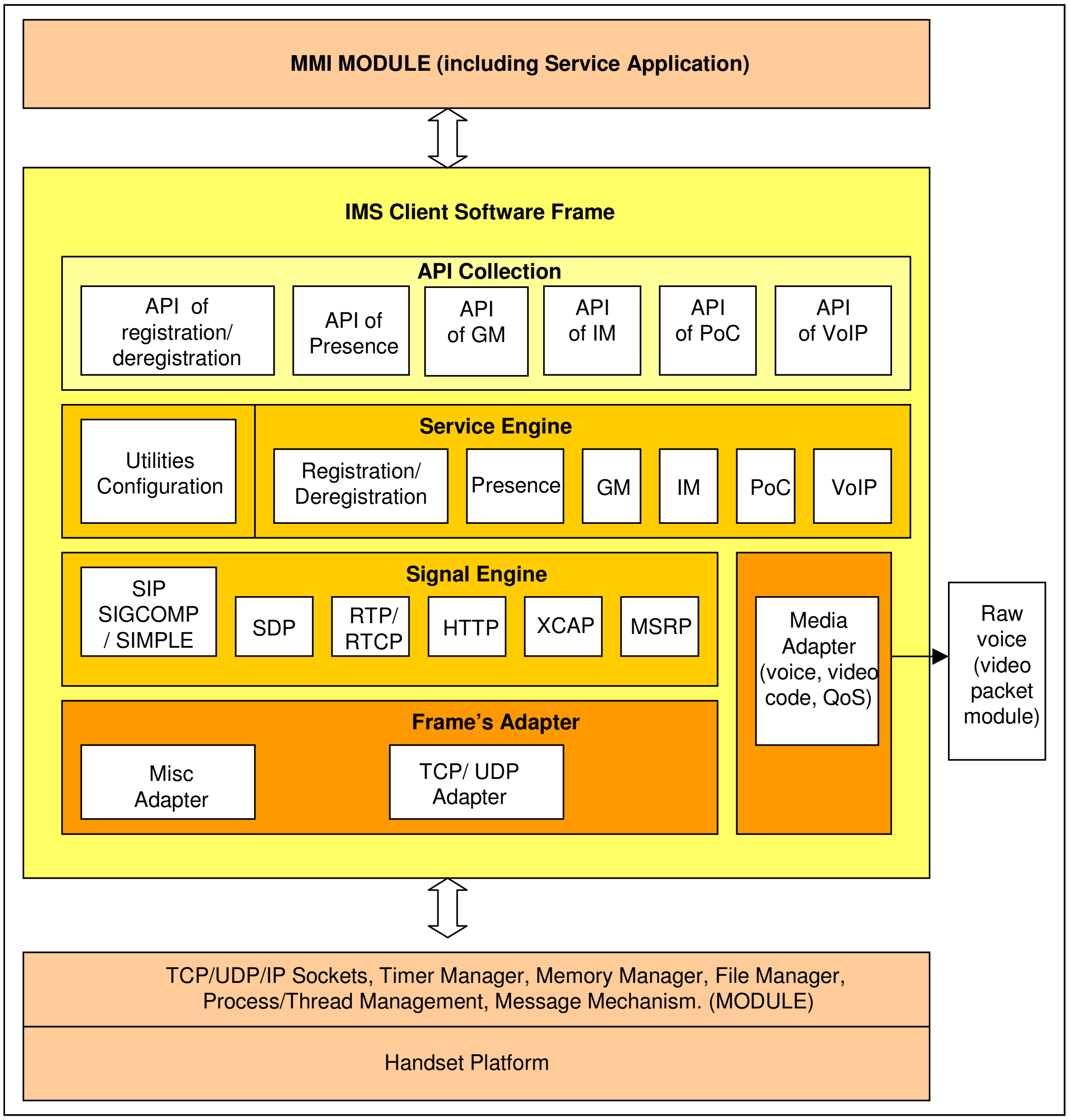

Figure 3: Terminal Software System Architecture

8. Dependencies for IMS in Malaysia

- IMS services are IP based and access independent, allowing for interoperability with any IP based network
- For IMS interconnectivity between different IMS providers, a secure IP connectivity is recommended. It is further recommended to avoid the use of public Internet network (www) for this interconnectivity.
- A regulatory framework for IP interconnect should be in place to launch inter-operator IMS services. Harmonized inter-working and interconnection arrangements when connecting to other network operators should align with commonly agreed industry standards and recommendations. As an example, the GSM Association offers a recommendation framework.

- IMS should be implemented to support dual stack IPv4/IPv6
- ENUM should be implemented to facilitate inter-working between telephony networks and applications in IMS.

9. Key Success Factors for IMS

- Affordable IMS terminals and services
- Rich IMS applications
- Large pool of content developers who are keen to develop and localize IMS application
- Quality of Service to handle real time applications should be incorporated into the IMS system
- A reasonable cost for international roaming of IMS Services
- Access agnostic and seamless interoperability,
- Availability of user friendly IMS terminals with rich features and capabilities such as big memory capacity, high processing power and adequate display size

10. Discussion and Challenges

- Services considered ideal for IMS can be and are being implemented without the need for an IMS such as Instant Messaging, VoIP, file sharing and peer to peer services
- The 3GPP group has defined a number of basic IMS services in its standard releases (e.g. presence in 3GPP Release 6). Since IMS services are based on IP, operators can provide the same or similar services utilizing other server based systems. As an example, the widespread deployment of instant messaging services today, the bulk of which are not IMS based
- To date there is no standard framework available to develop IMS clients. This is being somewhat addressed by the Open Mobile Alliance
- Lack of appealing IMS applications – this is a working group outcome to address this area by nurturing the developer community in Malaysia
- Compatibility, interoperability and legacy equipment challenges
- Interconnect between IMS domains
- High ratio of prepaid to postpaid users in Malaysia coupled with high data service traffic charges
- Business case justifications for IMS due to high cost of IMS platforms from traditional vendors

- At present, IMS services have not had the opportunity to be widely tested in the market even in developed countries – this presents a huge opportunity for Malaysia to build a developer community at the leading edge of IMS applications globally

- Pre-standard services and service incompatibility threaten long term business potential

- Transition and competence requirement to manage the new environment – this can be addressed with a comprehensive competence development strategy promoted at a national level

10.1 Considerations and Challenges of IMS from Service Creation Aspects

10.1.1 Service Capability Interaction

Interaction between service capabilities relies heavily on the service delivery platform (SDP). The Application Server (AS) or logical function that performs the interaction management will require full understanding of the control interfaces (ISC) of the service capabilities. This implies potential complications when there are hundreds of service applications to be deployed in the SDP which involve managing and coordinating service interaction between different types of application servers consist of SIP AS, OSA-SCS (for OSA gateway), and IM-SSF (for CAMEL/IN gateway):

- Different invocation mechanisms for different types of AS. For instance, SIP-AS is invoked based on SIP protocol standardized mechanism but OSA-SCS might be open service interface such as Web Service interface running on HTTP/SOAP protocol.

- Communication mechanism of different application server protocols such as SIP and non SIP protocols. For instance, an application that does not comply with IMS SIP extensions may not be able to extract or interpret the 3GPP P-Asserted Identity header, and therefore the service will not be exploited.

The complications led to technical challenges when more applications are deployed as it requires efficient management of how to recognize, handle and invoke among the service capabilities for rapid deployment. To tackle the challenge, it requires real time mechanisms to manage and control the conflicts of interactions that potentially may occur between the service capabilities.

At the time of writing, the 3GPP does not specify precisely the mechanism in achieving the interaction management, for instance, the way how it should coordinate multiple invocations of service capabilities and the way how it should handle the incompatibilities between the invocations.

10.1.2 Client Device Capability as The Service Receiving End

The client devices that used for IMS multimedia services required hardware platforms with high speed CPU performance, large memory size and battery capacity, and many active I/O ports support to deploy the IMS client software. Further, currently most of the IMS compliant client's devices are mainly for voice only use cases. To support IMS multimedia services, extensive development on software clients are required. These raise the question of the availability and price of devices/terminals that can be used to run the IMS multimedia services in short to mid term basis.

11. Electronic Numbering (ENUM) and its Role in IMS

ENUM stands for Electronic Numbering for Telephone Number Mapping, which is also one of the study groups within IETF. ENUM is a system that translates telephone numbers into Uniform Resource Identifiers and vice versa.

Currently email is probably the application that makes the greatest use of URIs and we are all familiar with the *ahmad@operator.com* format.

The translation of these numbers is performed by the DNS. ENUM exists primarily to facilitate the interconnection of systems that rely on telephone numbers with those that use URIs to route transaction.

For practical considerations, telephone numbers will also be used prior to the widespread adoption of online directory services for the simplicity of typing them on keypads.

ENUM is:

- A protocol to map E.164 telephone numbers into domain names
  - Defined in RFC 2916 (currently being revised)
- Very simple
  - Example: Phone number +44 1698 852881
becomes 1.8.8.2.5.8.8.9.6.1.4.4.e164.arpa
- Resulting name is resolved to an IP address using the standard IP DNS service

ENUM has gain greater attentions now since it has the potential to facilitate inter-working between telephony networks and applications in IMS. This is due to the fact that the telephone number can be used as the main address to introduce various applications that can communicate with the subscriber.

For example, this could be used for communications from the circuit switched telephone network (PSTN) to IP based services such as Voice over IP.

Figure 4 below shows the ENUM roles in establishing IMS to IMS calls and IMS to PSTN calls.

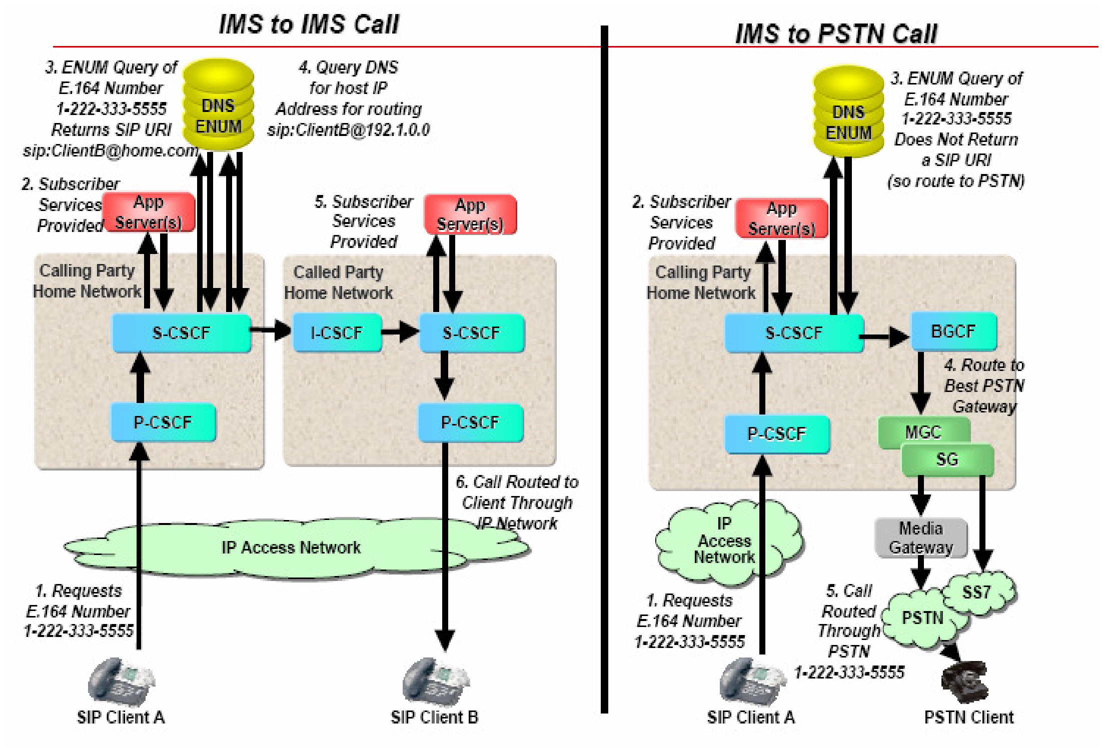

Figure 4: ENUM roles in IMS

12. Conclusion

This document is presented as a guideline to Malaysian Telcos, Service Providers and other interested parties when considering the adoption of the IMS. The IMS presents considerable opportunities for the development of new services and applications. These services can be rapidly deployed and targeted at niche customer segments and markets. The platform will also offer a simplified service creation environment with many common enabling services that applications can utilize (e.g. presence, location, etc.)

The IMS/NGN WG recommends that TISPAN Release 1 and IMS 3GPP Release 5 and above to be adopted when deploying an IMS system in Malaysia.

The IMS/NGN WG recognizes IP Multimedia Subsystem (IMS) is still evolving and this document addresses the key features, dependability and success factors to be considered in deploying IMS. Another release of this document would be published as IMS evolves.

It is essential that a Malaysian developer community is nurtured and guided in the development of IMS applications to spur growth of homegrown IMS applications in Malaysia.

13 Appendix

13.1 Reference Document

a) ***Convergence Technologies for 3G Networks***
Bannister, Mather and Coope, Pub. John Wiley

b) ***The IMS: IP Multimedia Concepts and Services, 2nd Ed.***
Poikselka, Niemi, Khartabil, Mayer, Pub. John Wiley

c) ***The 3G IP Multimedia Subsystem (IMS): Merging the Internet and the Cellular Worlds, 2nd Ed.***
Camarillo, García Martín, Pub. John Wiley

13.2 IMS Topics Categorization

The purpose of this page is to list the topics related to IMS, based on the list of 3GPP Specifications, RFCs and Internet Drafts.

General	
3GPP TS 22.228	Service Requirements for the IP Multimedia Core Network (IM CN) Subsystem - Stage 1
3GPP TS 23.228	IP Multimedia Subsystem (IMS) - Stage 2
Registration	
RFC 3327	SIP "Path" Extension Header Field for Registering Non Adjacent Contacts
RFC 3608	SIP Extension Header Field for Service Route Discovery during Registration
Diameter	
3GPP TS 29.109	GAA - Zh and Zn Interfaces based on the Diameter protocol - Stage 3
3GPP TS 29.229	Cx and Dx interfaces based on the Diameter protocol - Protocol Details
3GPP TS 29.230	Diameter Applications - 3GPP Specific Codes and Identifiers
3GPP TS 29.329	Sh Interface based on the Diameter protocol - Protocol Details
3GPP TS 32.299	Charging Management - Diameter Charging Applications
RFC 3588	Diameter Base Protocol
RFC 3589	Diameter Command Codes for 3GPP Release 5
RFC 4740	Diameter Session Initiation Protocol (SIP) Application
Identification	
3GPP TS 23.228	IP Multimedia Subsystem (IMS) - Stage 2
3GPP TS 29.229	Cx and Dx interfaces based on the Diameter protocol - Protocol Details
RFC 4282	The Network Access Identifier

3GPP TS 23.203	Policy and Charging Control Architecture
3GPP TS 29.207	Policy Control over Go Interface
3GPP TS 29.208	End to End Quality of Service (QoS) Signaling Flows
3GPP TS 29.209	Policy control over Gq Interface

Charging

3GPP TS 22.115	Service Aspects Charging and Billing
3GPP TS 32.240	Charging Architecture and Principles
3GPP TS 32.260	IP Multimedia Subsystem (IMS) Charging
3GPP TS 23.125	Overall high level functionality and architecture impacts of flow based charging - Stage 2
3GPP TS 23.203	Policy and Charging Control Architecture
3GPP TS 29.210	Charging Rule Provisioning over Gx Interface
3GPP TS 29.211	Rx Interface and Rx/Gx Signaling Flows
3GPP TS 23.203	Policy and Charging Control Architecture
3GPP TS 32.295	Charging Data Record (CDR) Transfer
3GPP TS 32.296	Online Charging System (OCS): Applications and Interfaces
3GPP TS 32.297	Charging Data Record (CDR) File Format and Transfer

Security

3GPP 33-series	3GPP Specifications related to Security

QoS

3GPP TS 23.107	Quality of Service (QoS) Concept and Architecture
3GPP TS 23.207	End to End Quality of Service (QoS) Concept and Architecture
3GPP TS 29.208	End to End Quality of Service (QoS) Signaling Flows

OSA

3GPP TS 22.127	Service Requirement for the Open Service Access (OSA) - Stage 1
3GPP TS 23.198	Open Service Access (OSA) - Stage 2
3GPP TS 29.198	29.198 series: Open Service Access (OSA) API
3GPP TS 29.199	29.199 series: OSA Parlay X Web Services

CAMEL

3GPP TS 22.078	CAMEL Service description - Stage 1
3GPP TS 23.078	CAMEL Phase 4 - Stage 2
3GPP TS 23.278	CAMEL Phase 4 - Stage 2 - IM CN Inter-working
3GPP TS 29.078	CAMEL Phase X - CAMEL Application Part (CAP) specification
3GPP TS 29.278	CAMEL Phase 4 - CAP specification for IP Multimedia Subsystems (IMS)
3GPP TS 29.002	Mobile Application Part (MAP) specification

WLAN Access

3GPP TS 22.234	Requirements on 3GPP system to Wireless Local Area Network (WLAN) inter-working
3GPP TS 23.234	3GPP System to WLAN Inter-working - System Description
3GPP TS 24.234	WLAN User Equipment (WLAN UE) to Network Protocols - Stage 3
3GPP TS 29.161	Inter-working between the PLMN supporting Packet based Services with WLAN Access and PDNs
3GPP TS 29.234	3GPP System to WLAN Inter-working - Stage 3
3GPP TS 32.252	WLAN Charging
3GPP TS 33.234	WLAN Inter-working Security

CSICS: Circuit Switched IMS Combinational Services

3GPP TS 22.279	Combined CS and IMS Sessions - Stage 1
3GPP TS 23.279	Combining Circuit Switched (CS) and IMS Services - Stage 2
3GPP TS 24.279	Combining Circuit Switched (CS) and IMS Services - Stage 3

Presence

3GPP TS 22.141	Presence Service - Stage 1 – Requirements
3GPP TS 23.141	Presence Service - Stage 2 – Architecture and functional description
3GPP TS 24.141	Presence service using the IP Multimedia (IM) Core Network (CN) subsystem - Stage 3
3GPP TS 26.141	IMS Messaging and Presence - Media formats and codecs
3GPP TS 33.141	Presence service – Security
OMA Presence Simple	OMA Presence Simple V1.0.1 Approved Enabler
IETF standards: Presence	RFCs and Drafts related to Presence
IETF standards: XCAP	RFCs and Drafts related to XCAP
IETF standards: URI List Services	RFCs and Drafts related to URI List Services

Push to talk over Cellular (PoC)

3GPP TR 23.979	Push to talk over Cellular (PoC) Services - Stage 2
3GPP TS 32.272	Push to talk over Cellular (PoC) charging
OMA Push to talk Over Cellular (PoC)	OMA Push to talk Over Cellular V1.0.2 Approved Enabler
IETF standards: PoC	RFCs and Drafts related to PoC
IETF standards: Presence	RFCs and Drafts related to Presence
IETF standards: XCAP	RFCs and Drafts related to XCAP
IETF standards: URI List Services	RFCs and Drafts related to URI List Services

13.3 Abbreviations and Acronyms

3GPP	Third Generation Partnership Project
AAA	Authentication, Authorization and Accounting
ACA	Accounting Answer
ACR	Accounting Request
AoR	Address Of Record
API	Application Program Interface
AS	Application Server
ARPU	Average Revenue Per User
ATM	Asynchronous Transfer Mode
AUC	Authentication Center
AUTN	Authentication Token
AV	Authentication Vector
BGCF	Breakout Gateway Control Function
BICC	Bearer Independent Call Control
CAMEL	Customized Application for Mobile Network Enhanced Logic
CAP CAMEL	Application Part Capex Capital Expense
CCA	Credit Control Answer
CCC	Credit Control Client
CCF	Charging Collection Function
CCR	Credit Control Request
CDF	Charging Data Function
CDR	Charging Data Record
CGF	Charging Gateway Function
COPS	Common Open Policy Service
CS	Circuit Switched
CSCF	Call SCF
CSEQ	Context Sequence (Number)
DiffServ	Differentiated Services
DNS	Domain Name System
DSCP	Differentiated Services Code Point
ECF	Event Charging Function
FTP	File Transfer Protocol
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
GTP	GPRS Tunneling Protocol
HLR	Home Location Register
HSS	Home Subscriber Server

HTTP	Hypertext Transport Protocol
I-CSCF	Interrogating CSCF
IETF	Internet Engineering Task Force
IKE	Internet Exchange Key
IM	Instant Messaging
IMS	IP Multimedia Subsystem
IM-SSF	IP Multimedia Service Switching Function
IntServ	Integrated Services
IP	Internet Protocol
IPR	Intellectual Property Right
IP-CAN	IP Connectivity Access Network
IPSec	IP Security
IPv4	Internet Protocol Version 4
IPv6	Internet Protocol Version 6
ISC	IMS Service Control (Interface)
ISDN	Integrated Services Digital Network
ISIM	IMS Subscriber Identity Module
ISUP	ISDN User Part
ITU-T	International Telecommunication Union
J2EE	Java 2 Platform, Enterprise Edition
IWF	Inter-working Function
MAA	Multimedia Authentication Answer
MAP	Mobile Application Part
MAR	Multimedia Authentication Request
Megaco	Media Gateway Control
MGCF	Media Gateway Control Function
MGW	Media Gateway
MIME	Multipurpose Internet Mail Extension
MMD	Multimedia Domain
MRF	Multimedia Resource Function
MRFC	MRF Control
MRFP	MRF Processor
MSC	Mobile Switching Center
MTP	Message Transfer Part
NAI	Network Access Identifier
NASS	Network Attachment Subsystem
OCF	Online Charging Function
OPEX	Operating Expense
OSA	Open Service Access
OTA	Over The Air

OMA	Open Mobile Alliance
PCM	Pulse Code Modulation
PCS	Personal Communication System
P-CSCF	Proxy CSCF
PDA	Personal Digital Assistant
PDF	Policy Decision Function (Same as Policy Decision Point [PDP])
PDG	Packet Data Gateway
PDP	Packet Data Protocol; Also: Policy Decision Point (Same as PDF)
PEP	Policy Enforcement Point
PHB	Per Hop Behavior
PLMN	Public Land Mobile Network
PoC	Push To Talk Over Cellular
PS	Packet Switched
PSTN	Public Switched Telephone Network
PTT	Push To Talk
QoS	Quality Of Service
RACS	Resource And Admission Control Subsystem
RADIUS	Remote Authentication Dial In User Service
RAND	Random Number
REQ	Request
RES	Response
RFC	Request For Comments
RSVP	Resource Reservation Protocol
RTCP	Real Time Transport Control Protocol
RTP	Real Time Transport Protocol
RTSP	Real Time Streaming Protocol
SA	Security Association
SAA	Server Assignment Answer
SAR	Server Assignment Request
SBLP	Service Based Local Policy
SCF	Session Control Function
SCP	Service Control Point
SCS	Service Capability Server
S-CSCF	Serving CSCF
SCTP	Streaming Control Transmission Protocol
SDP	Session Description Protocol
SEG	Security Gateway
SGSN	Serving GPRS Support Node
SGW	Signaling Gateway
SIM	Subscriber Identity Module

SIP	Session Initiation Protocol
SLF	Subscriber Location Function
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
TISPAN	Telecoms and Internet Converged Services and Protocols for Advanced Networks
TCP	Transmission Control Protocol
THIG	Topology Hiding Inter-Network Gateway
TLS	Transport Layer Security
TUP	Telephone User Part
UA	User Agent
UAA	User Authorization Answer
UAC	UA Client
UAR	User Authorization Request
UAS	UA Server
UDP	User Datagram Protocol
UICC	UMTS Integrated Circuit Card
UMTS	Universal Mobile Telecommunications System
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
USIM	UMTS Subscriber Identity Module
VoIP	Voice over IP
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network
WWW	World Wide Web
xDSL	Term used for all forms of technology using a Digital Subscriber Line
XRES	Expected Response

Acknowledgements

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