IMS WHITE PAPER SERIES: PART 1

Introduction to IMS

Standards, protocols, architecture and functions of the IP Multimedia Subsystem

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Introduction to IMS

Standards, protocols, architecture and functions of the IP Multimedia Subsystem

This paper is intended to provide a brief overview of the relevant standards and protocols to the IP Multimedia Subsystem (IMS), the architecture of IMS and the functional elements that will create an IMS network.

EDITORS' NOTE

This is the first in a series of white papers from the Embedded Communications Computing business of Motorola on the IP Multimedia Subsystem (IMS) architecture.

This paper is intended to provide a brief overview of the relevant standards and protocols, the architecture of IMS and the functional elements that will create an IMS network.

Other papers in the series will present a proof-of-concept IMS common platform based on AdvancedTCA® communications servers, developed in collaboration with Intel®; and how to architect certain network elements for deployment using ATCA® communications servers.

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IMS CORE ATTRIBUTES

The IP Multimedia Subsystem (IMS) provides an all IP multimedia architecture supporting the necessary core attributes to enable rich and demanding services to the subscriber. These attributes are:

- Quality of Service (QoS), without which real-time multimedia services cannot be reliably provided to paying subscribers
- The ability to grant access to services while understanding the needs of the service to ensure adequate network resources are provided for the duration of the requested service
- The ability for the service provider to charge appropriately for the service. For example, a subscriber sets up a voice call and then mid-session decides to include video conferencing in addition to speech. The IMS architecture ensures that events are captured to allow for appropriate charging of the subscriber
- The ability for the service provider to rapidly add new revenue increasing services in order to increase Average Revenue Per User (ARPU)
- The ability to "mix" services possibly from different providers, known as service blending. For example, providing a gaming service (from one service provider) while also allowing a Push-To-Talk (PTT) voice service (from another provider)—these being provided to the subscriber to enhance the gaming experience at the subscriber's request.

3GPP IMS STANDARDS

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. 3GPP Release 6 includes further functional enhancements to IMS.

OTHER RELATED STANDARDS BODIES

A number of complimentary standards bodies are working with the 3GPP to provide additional standards content (e.g., Internet Engineering Task Force [IETF]) and to ensure interoperability and standardization of additional service requirements (e.g., Open Mobile Alliance).

A number of these additional bodies are listed below:

INTERNET ENGINEERING TASK FORCE

The IETF (www.ietf.org) is associated with the IMS architecture in a collaborative way. The terms of the collaboration are documented in RFC3113 and RFC3131. The 3GPP has adopted a number of core protocols and architectural concepts.

Broad areas of collaboration include the areas of IPv6 and Domain Name System (DNS), as well as operations and management including Common Open Policy Service (COPS); and also in the session control arena using Session Initiation Protocol (SIP) [RFC3261] as the chosen protocol.

The protocol originally detailed in RFC2543 was not mature or feature-rich enough for the identified needs of IMS. Therefore after much deliberation, RFC3261 was developed to address the core session establishment needs of IMS.

Even with RFC3261 in place, there was still a need for additional complimentary RFCs to address the full and future needs of IMS. The IETF created a new working group—SIPPING—to handle new requirements being submitted.

A number of other IETF core protocols such as Session Description Protocol (SDP), Diameter (an Authentication, Authorization and Accounting protocol) and Real-time Protocol (needed for end-to-end delivery of multimedia) were adopted for use by the 3GPP.

3RD GENERATION PARTNERSHIP PROJECT 2

3GPP2 (www.3gpp2.org) is a project that builds upon the 3GPP IMS work and includes this into what the 3GPP2 call Multi-Media Domain (MMD). There are many similarities but also some key differences such as mandatory codec usage.

For example, IMS specifies the requirement to support Adaptive Multi-Rate (AMR) codec; MMD specifies Enhanced Variable Rate CODEC (EVRC). There are also differences in charging, policy control, and legacy CAMEL services (no support), to name a few differences.

OPEN MOBILE ALLIANCE

In June 2002, the Open Mobile Alliance (OMA, www.openmobilealliance.com) was formed as an alliance working towards standardization of mobile data services.

The first example of work undertaken by the OMA is available through published release packages—the first of these being Push-To-Talk over Cellular (PoC) V1.0.

The OMA, by undertaking work such as this, allows multiple service providers to collaborate on key service supporting functions.

For example, session management, QoS and security, such that services can be provided across service provider domains in an interoperable manner.

EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE

ETSI TISPAN (http://portal.etsi.org/portal_common/home.asp?tbkey1+TISPAN) functional architecture Release 1 document details, in accordance with the ITU-T (www.itu.int/ITU-T), the general reference model for next-generation networks (NGN).

Essentially the service layer is based on the IMS architecture, but other work defines Public Switched Telephone Network (PSTN) emulation within the NGN and takes account of wireline/broadband network requirements in order to participate in the NGN based on the IMS architecture.

The above bodies, as well as other bodies such as CableLabs (www.cablelabs.com) and the ITU, through the IETF work activities, show an important point—in order to really produce an architecture that is device- and access network agnostic there is a need for industry collaboration.

IMS PROTOCOLS

A number of key protocols have been identified and endorsed by the 3GPP to ensure interoperability between vendor equipment.

An overview of these key protocols is given below.

SESSION INITIATION PROTOCOL

The IETF Session Initiation Protocol (SIP) as described in RFC3261 is an application layer protocol for establishing, terminating and modifying multimedia sessions within an IP network.

SIP has been embraced as the specified protocol in support of session control protocol for IMS which follows a client server model.

SESSION DESCRIPTION PROTOCOL

Session Description Protocol (SDP) is a text-based protocol which describes the multimedia session.

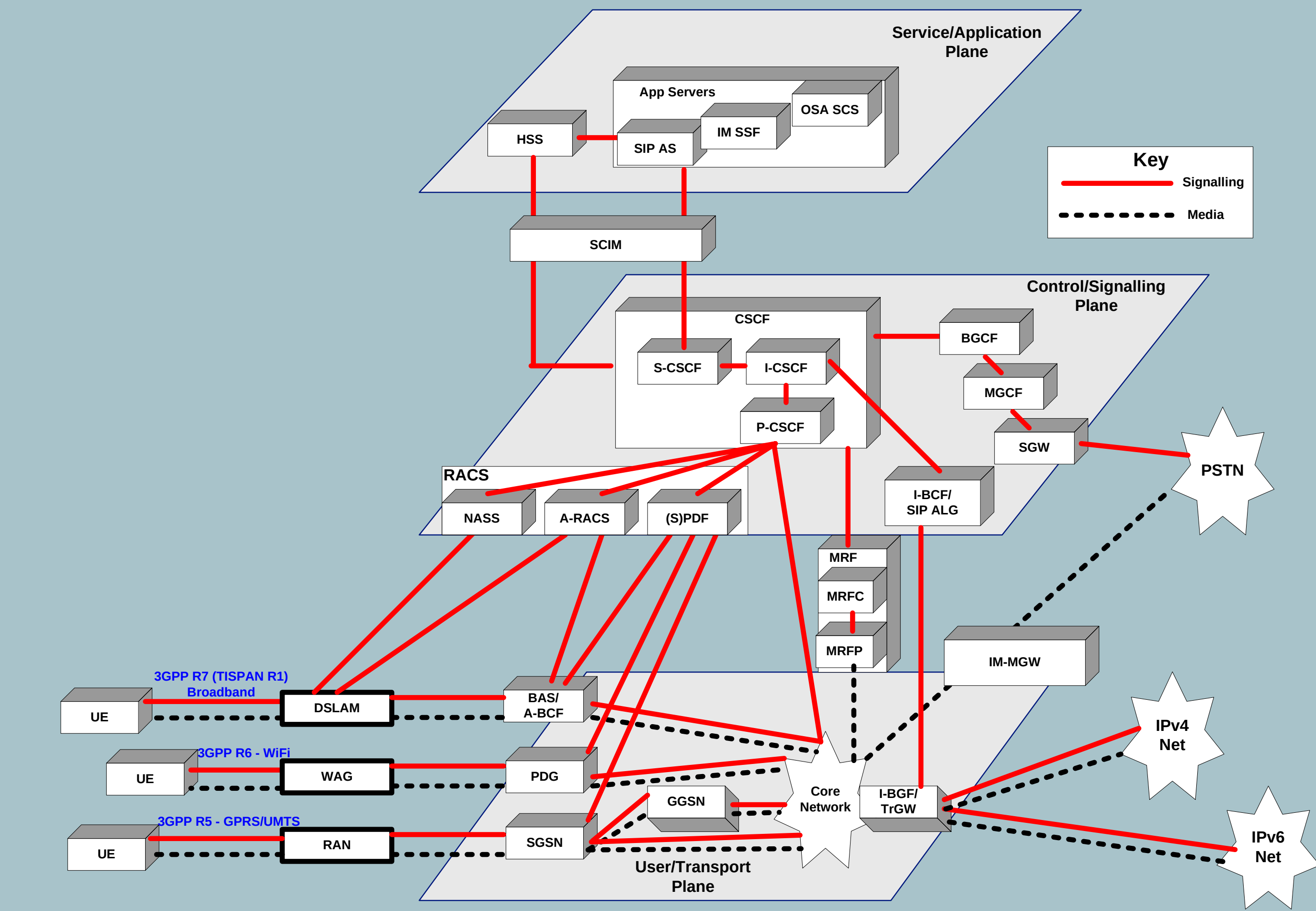
For example, when initiating a session the caller and callee indicate and exchange their media capabilities as well as receive address and port number.

SDP provides an offer/answer model where media attributes such as codec types and capabilities can be offered and negotiated.

REAL-TIME PROTOCOL

Real-time Protocol (RTP), specified in RFC3550, provides a mechanism to transport real-time multimedia traffic including video and audio over unreliable transport mediums such as User Datagram Protocol (UDP).

RTP contains the necessary attributes to ensure correct media buffering and jitter management by providing a timing relationship between source (generate) and sink (terminate) of the media session.



The 3GPP IMS Architecture including ETSI TISPAN components

DIAMETER

The Diameter protocol is specified in RFC3588 and was chosen for use with IMS as the AAA (Authentication, Authorization and Accounting) protocol. Diameter is an evolution of the more familiar RADIUS (RFC2865) protocol. Diameter is the base protocol that is used along with the Diameter "application" which provides environment extensions that are defined within the IMS specifications.

H.248 MEGACO

MEdia **GA**teway **CO**ntrol (MEGACO) protocol is a means for signaling functions to control media serving functions within the IMS environment. MEGACO was co-developed by the ITU-T and IETF and is also referred to as H.248.

COMMON OPEN POLICY SERVICE

Common Open Policy Service (COPS) protocol is specified in RFC2748. This protocol used within the IMS environment is used to transport policies between Policy Decision Points (PDPs) and Policy Enforcement Points (PEPs).

IMS ARCHITECTURE

The IMS architecture is evolving across multiple 3GPP releases. For example, Release 6 includes Wireless LAN access mechanisms; and Release 7 includes broadband/wireline access capabilities.

The figure above shows the 3GPP IMS architecture including ETSI TISPAN functionality in order to highlight the coordinated compatibility between the efforts.

There are three distinct operational planes within the IMS architecture: the application plane, control plane and the media plane.

The **application plane** contains a number of application server types. These are all SIP entities as expected within the IMS architecture.

These servers host and execute services and can operate in a number of SIP functional modes i.e., SIP UA (User Agent), a terminating function; SIP B2BUA (Back-to-Back User Agent) which acts like two back-to-back SIP user agents or as a SIP proxy server.

The **control plane** deals with session signaling and comprises a number of distinct functions to process the signaling traffic flow, such as the Call Session Control Functions (x-CSCF), Home Subscriber Server (HSS), Media Gateway Control Function (MGCF) and Media Resource Function Controller (MRFC).

Using protocols such as SIP, Diameter and H.248 MEGACO, the various elements are able to establish subscriber requested services.

The **media plane** transports the media streams directly between subscribers; and between subscribers and IMS media generating functions, such as the media resource function processor acting as a media announcement server.

CORE IMS FUNCTIONS

There are a number of core IMS functions specified by the 3GPP. These functions are not necessarily separate physical functions and, in most cases, optimization is made through combining IMS functions in a particular hardware shelf to provide economy based on subscriber scale.

In the future, it is much more likely that a dedicated shelf supporting higher subscriber density as a specific function will be deployed.

A brief description of the core IMS functions:

CALL SESSION CONTROL FUNCTION

The Call Session Control Function (CSCF) is a SIP server which processes the IMS signaling traffic in order to control multimedia sessions. There are three types of CSCF:

- Proxy CSCF (P-CSCF): The initial point of contact for signaling traffic in to the IMS. A user is allocated a P-CSCF as a part of the registration process, and provides a two-way IPsec association with the user, all signaling traffic traverses the P-CSCF for the duration of the session.
- Serving CSCF (S-CSCF): Provides the service coordination logic to invoke and orchestrate the application servers needed to deliver the requested service. The S-CSCF interacts with the HSS in order to determine user service eligibility by downloading the user profile; the S-CSCF is allocated for the duration of the registration.
- Interrogating CSCF (I-CSCF): A SIP proxy that provides a gateway to other domains, such as other service provider networks. The I-CSCF may encrypt sensitive domain information a function referred to as Topology Hiding Inter-network Gateway (THIG) before forwarding the traffic.

APPLICATION SERVERS

An application server hosts and executes services and can run in a number of classical SIP operational modes.

The application servers mentioned above are attached to the S-CSCFs to host and serve IMS services.

SERVICE CAPABILITY AND INTERACTION MANAGER

The Service Capability and Interaction Manager (SCIM) function emerged later in the 3GPP IMS architectural definition stages.

It allows the ability to provide more complex service brokering above and beyond that allowed by the CSCF.

It can take account of the callee presence state, calendar, etc. in order to provide more intelligent responses to the caller without burdening the application servers in the process.

This layer can be inserted in to existing IMS architectures, invisibly looking like an S-CSCF to the application server, and an application server to the S-CSCF.

HOME SUBSCRIBER SERVER

The Home Subscriber Server (HSS) is a centralized database storing the subscriber profile information. This information is predominantly accessed using the Diameter protocol by the S-CSCF for validation of the subscriber and for determining authorized service capabilities.

Also the I-CSCF, SCIM and the application servers have access to the HSS database.

MEDIA RESOURCE FUNCTION

The Media Resource Function (MRF) comprises two nodes: the Controller and Processor. The MRFC (controller) is situated in the signaling plane as a SIP User Agent; and the MRFP (processor) is situated in the media plane and provides media related functions, such as serving voice announcements, voice mixing (for conferencing) and video conferencing.

The defined interface between the MRFC and MRFP in order to control and invoke media resources is H.248 MEGACO.

MGW/MGCF/SGW/BGCF

The Media Gateway (MGW)/Media Gateway Control Function (MGCF) and Signaling Gateway (SGW) collectively represent equipment that provides interworking with the legacy PSTN.

Interworking of the SIP to PSTN signaling traffic, and the circuit switched to RTP based packet media flow, is achieved using the SGW and MGW functions respectively.

The MGCF controls the MGW media flow over a H.248 MEGACO interface. Transportation of signaling traffic between the MGCF and SGW is achieved using Signaling Control Transport Protocol (SCTP) (RFC2960).

A Border Gateway Control Function (BGCF) identifies if a session terminates on the PSTN and determines which MGCF should handle it.

CONCLUSION

With the declining service provider revenue from voice services as voice becomes a commodity item, there is a need to introduce new chargeable services to stop a service provider being solely a low revenue bit-pipe.

IMS allows differing service offerings by region, by customer demographic, and by service level.

Service providers do not need to wait for the killer application but will now be able to extract value from many applications tailored to the needs of multiple client “micro-bases”.

MORE INFORMATION

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GLOSSARY OF TERMS

3GPP...........................3rd Generation Partnership Project
3GPP2.........................3rd Generation Partnership Project 2
AAA.............................Authentication, Authorization and Accounting
AdvancedTCA ....Advanced Telecom Computing Architecture (ATCA)
AMR ....Adaptive Multi-Rate
ARPU ....Annual Revenue per User
ATCA...........................Advanced Telecom Computing Architecture (AdvancedTCA)
BGCF ....Border Gateway Control Function
COPS ....Common Open Policy Service
CSCF...........................Call Session Control Functions
DNS.............................Domain Name System
ETSI ....European Telecommunications Standards Institute
EVRC ....Enhanced Variable Rate Codec
HSS.............................Home Subscriber Server
IETF.............................Internet Engineering Task Force
IMS..............................Internet Protocol (IP) Multimedia Subsystem
I-CSCF ....Interrogating CSCF
ITU-T ....International Telecommunication Union-Telecommunications
MEGACO ....Media Gateway Control
MGCF..........................Media Gateway Control Function
MGW ....Media Gateway
MMD............................Multi-Media Domain
MRF.............................Media Resource Function
MRFC..........................Media Resource Function Controller
MRFP ....Media Resource Function Processor
NGN ....Next-generation network
OMA ....Open Mobile Alliance
P-CSCF.......................Proxy CSCF
PDP.............................Policy Decision Point
PEP ....Policy Enforcement Points
PoC ....Push-To-Talk over Cellular
PSTN...........................Public Switched Telephone Network
PTT..............................Push-To-Talk
QoS ....Quality of Service
RTP ....Real-time Protocol
SCIM ....Service Capability and Interaction Manager
S-CSCF ....Serving CSCF
SCTP...........................Signaling Control Transport Protocol
SDP.............................Session Description Protocol
SGW............................Signaling Gateway
SIP ....Session Initiation Protocol
SIP B2BUA..................SIP Back-to-Back User Agent
SIP UA.........................SIP User Agent
THIG............................Topology Hiding Internetwork Gateway
TISPAN ....Telecoms & Internet converged Services & Protocols for Advanced Networks
UDP.............................User Datagram Protocol

Through its Embedded Communications Computing business, Motorola enables the leading equipment manufacturers in telecommunications, medical imaging, defense and aerospace, and industrial automation to develop the communications computing infrastructure that will bring seamless mobility to life.

Motorola is leading the industry-wide development of open communications servers, common platforms that support a wide range of applications.

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For more than 20 years, Motorola has driven open standards and pioneered technologies based on them. The company continues to support its customers over the long term by simplifying their ability to take advantage of advances in technology.

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