A Study on IP Multimedia Subsystem Architecture & its Application Servers

Half Brick Project

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Introduction

The communications industry as a whole is undergoing an evolutionary transformation, whereby the line between fixed-mobile broadband service providers are blurring, and where in the past subscribers have historically had multiple service provider relationships, are now able to get most of their communications services provided by a single provider.

While today's owners of multimedia-capable, multi-purpose mobile communication devices are demanding rich-media, interactive services which can take greater advantage of the technical capabilities of their devices, the traditional issues of network infrastructure—connecting the pipes to boxes, is giving way to new issues of service delivery and execution infrastructure, which requires running industry standards based services across multiple platforms, networks, and applications.

In order to meet the demands of this fast changing business climate, Content Service Providers (CSPs) need a horizontal network infrastructure which will allow them to rapidly develop, deploy, and deliver a large number of new services, which in many cases will have been developed by a 3rd party content and service provider[1].

IMS – IP Multimedia Subsystem – is an international, recognized industry standard specification defined by the 3rd Generation Partnership Project (3GPP) in Release 5 & 6, originally for 3G UMTS mobile networks. It specifies interoperability and roaming; provides bearer control, charging and security. The standard supports multiple access types – including GSM, WCDMA, CDMA2000, Wireline broadband access and WLAN. Because of its general applicability outside the wireless access domain, other standards bodies that have subsequently adopted the majority of the 3GPP IMS specifications as the underpinning of their own architectural standards. These forums include the 3rd Generation Partnership Project 2 (3GPP2) under the Multi-Media Domain (MMD) specifications, the Open Mobile Alliance (OMA), and the European Telecommunications Standard Institute (ETSI) [2].

IMS enables services to be delivered in a standardized, well-structured way that truly makes the most of layered architecture. At the same time, it provides a future-proof architecture that simplifies and speeds up the service creation and provisioning process, while enabling legacy interworking. 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.

What is more, IMS is well integrated with existing voice and data networks, while adopting many of the key benefits of the IT domain. Since the primary concern is IP and application layer issues, non-mobile network operators, such as fixed-line operators and cable operators, are also beginning to adopt IMS as part of their broader move to all-IP networks. On longer term, IMS enables a secure migration path to an all-IP architecture that will meet end-user demands for new enriched services. That makes IMS a key enabler for fixed-mobile convergence and value-based charging. And for those reasons, IMS will become preferred solution for fixed and mobile operators' multimedia business.

IMS is not new in that its underlying technologies and concepts have been discussed by standards and technology groups for some time. But what is new is that the IMS specifications have gone through two 3GPP releases, with increasing adoption by CSPs, as well as vendors and Network Equipment Providers (NEPs) supplying the associated network equipment, applications and devices. IMS delivers a reusable platform for new service experimentation, deployment, and integration, resulting in the expansion of the types of communications services available to consumer and enterprise end-users [1].

The IMS standard is based upon the widely adopted Internet standard technology called Session Initiation Protocol (SIP). SIP is at the heart of the IMS network architecture, providing the real-time, peer-to-peer, multiparty and multi-media capabilities of IMS. The application services layer of IMS networks support SIP interfaces and IMS SIP application servers, to reduce the complexity of IMS applications as well as to lead to enhanced, feature rich network services.

IMS specifies a core set of network functional entities, which support access to the SIP-based communication services provided by CSPs. Instead of inventing new protocols, IMS builds upon existing Internet protocols, as specified by IETF, such as SIP, Session Description Protocol (SDP), and Diameter, which enables the creation of a complete and robust real-time, peer-to-peer, multimedia network architecture. IMS provides for network elements, such as CSCF, HSS, MRF, and others, whose functionality and external and intra-IMS interfaces have been standardized.

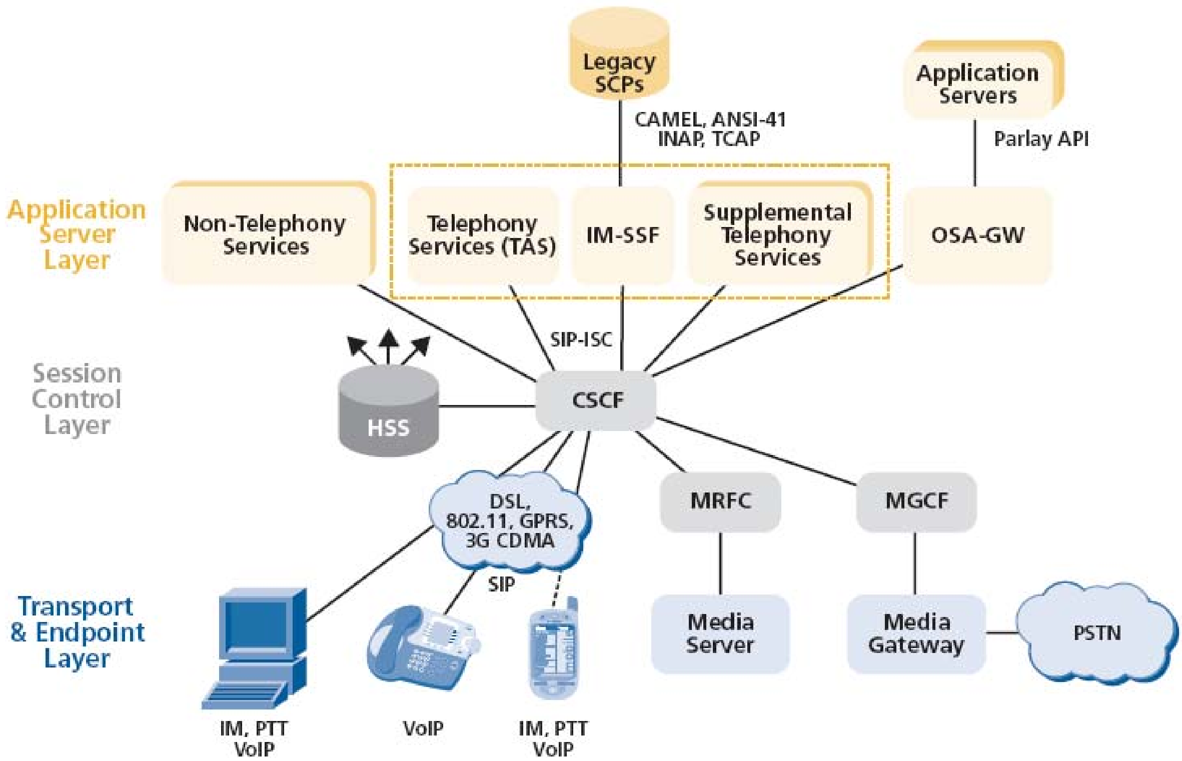

Fig. 1. Simplified View of the IP Multimedia Subsystem (IMS) [3]

Benefits For Service providers

The key benefits derived by service providers from deploying IMS networks is new and increased revenue streams, and reduction in capital and operating expenses. By consolidating application interfaces into the application server, the creation of new multimedia services can be developed and delivered in a very short time-to-market cycle while dramatically reducing the support cost of the applications. IMS enables the creation of new services which were not possible previously, or might have been too costly and complex to implement, such as PoC or video sharing.

Because IMS supports roaming between different networks, new services developed to a single platform can be made available across multiple access networks. This will enable CSPs to increase customer loyalty, increase ARPU from their installed base, and reduce churn. IMS also enables CSPs to monetize the fast pace of multimedia-enabled mobile device development, and end-user’s changing needs. This requires the ability for CSPs to mix-and-match, and integrate different services to come up with new services. IMS enables CSPs to take an existing voice-based application, and integrate with multimedia sharing and video-enabled services. Or Web-based applications can be mobile/real-time/multimedia-enabled[1].

Using IMS, operators can adopt a strategy of first exploring the opportunities of IP multimedia, and then taking appropriate steps to mass-market IP multimedia services, according to market and business motivations. The hard lessons of the Internet bubble have brought us back to sound business logic, based on increased revenues and cost control. The introduction of new services and capabilities must not disturb the current profitable mix of telephony services. They should rather use it as a base for a superior user experience making it even more compelling.

By deploying an IMS network architecture, CSPs can reduce the need to build-out multiple silos of network elements each time they add a new service. By deploying a horizontal, IP-based, converged service delivery architecture based on the IMS standard, CSPs can implement new services on existing network infrastructure, reducing the costs associated with new equipment purchases. And in the longer term, IMS supports CSPs need to reduce the costs and complexities of managing multiple, parallel network elements, reducing their overall operating expenses.

IMS provides sound, business-focused evolution options for delivering attractive, easy-to-use, reliable and profitable multimedia services. It also enables operators achieve fixed–mobile convergence. Strategies are in place for operators to begin rolling out IMS-based services that take advantage of fast, flexible service creation and provisioning capabilities, while also providing for legacy interworking and combinational services that make the most of existing investments. Operators can then build onwards toward the all-IP vision of offering rich, multi-access multimedia services.

Benefits for End-users

With IMS, end-users will be opened up to a new world of communication services which they might have associated mainly with the PC/Internet world, such as instant messaging and presence. In addition, there are new features in IMS services which end-users might never have thought about. For end-users, the benefits include richer, multimedia user experiences, roaming, new IP-based services, simplified identity management, personalization, ease-of-use, security and mobile-fixed-Internet integration. With the proliferation of rich-media capable mobile devices, both consumer and enterprise end-users have become very savvy about the personalized, interactive, and near real-time demands they have about their day-to-day communication services[1].

Features & Capabilities

The IMS architecture specifies a number of common functions and service enablers which can be reused across multiple access networks to enable multimedia services.

Multimedia session management

Multimedia session control and management in IMS is made possible through the use of SIP as the standard session control protocol. IMS enables the media session between to end-points to consist of any type of media content, and IMS also enables a session to be dynamically modified at run-time. This means media types can be added/dropped dynamically, depending the on the nature of the application[3].

Quality of Service

IMS provides CSPs with a standardized network element, the Policy Decision Function (PDF), which controls and monitors the packet network traffic into an IMS network from a GPRS and UMTS network. Through the PDF, IMS enables CSPs to deliver real-time IP network services at specified QoS levels.

Mobility management

IMS provides the HSS and CSCF elements to enable mobility management. The HSS is the data store for subscriber registration and location information, which is supplied to the CSCFs for session set-up and management, and message forwarding to IMS and non-IMS networks.

Service control

IMS networks address service control through the HSS and CSCF elements. As an end-user registers into the IMS network, the CSCF downloads the Subscriber Service Profile (SSP) from the HSS, which contains each individual's services provisioning information. For each subscriber, the SSP enables CSCFs to know which services need to be executed, in which order, address of the appropriate IMS application server(s), and the order in which the application server needs to execute the specified services. IMS enables CSPs to implement a common service control, execution and interaction platform for all services and subscribers accessing their networks[1].

Access-aware networks

Different services have different requirements. In order for different services to be executed properly, the network has to be aware of the different characteristics of the access methods. Multi-access functionality is inherent in the IMS architecture. This will enable the delivered service to be adapted to the characteristics and capabilities of the currently selected device and its network access method[2].

Standard interfaces

With IMS, 3GPP has delivered a standardized architecture and interfaces for deploying multimedia IP services across multiple access networks. This facilitates the development of new and innovative SIP/IMS services by 3rd party developers and service providers, independent of the IMS network deployments by CSPs, thereby fostering cross-network service integration, interoperability, and roaming.

Safe communication

With IMS, operators can implement end-to-end communications services built around a number of IMS security and network architecture cornerstones. These include the fundamental IMS attribute that *operator-controlled* services are provided to *authenticated* users. The originating operator has end-to-end responsibility in the operator community: no services are delivered to anonymous or untrustworthy end-users, and no service requests are relayed from anonymous and untrusted operators and enterprises. In addition, payload (primarily non-voice and video) is checked for viruses. Access domain security is provided through user authentication and Single Sign On[2].

Simple access to services

Once authenticated through an IMS service, the user is able to access all the other IMS services that he is authorized to use. Authentication is handled by the CSCF as the user signs on. When it receives a service request, the SIP Application Server (AS) can verify that the user has been authenticated.

Service interoperability

IMS enables the reuse of inter-operator relations. Rather than develop different interconnect relations and agreements for each service, IMS enables a single inter-operator relationship to be established and built upon for each service [2]. Once IMS is in place, access to other users' services is an IMS network issue, common to all IMS personal services, as shown in Figure 2. The requesting user's operator service does not need to be involved in routing the request. The inter-operator network-to-network interface is established in IMS , and the general IMS inter-operator service agreement, routing, service network access point and security are all reused.

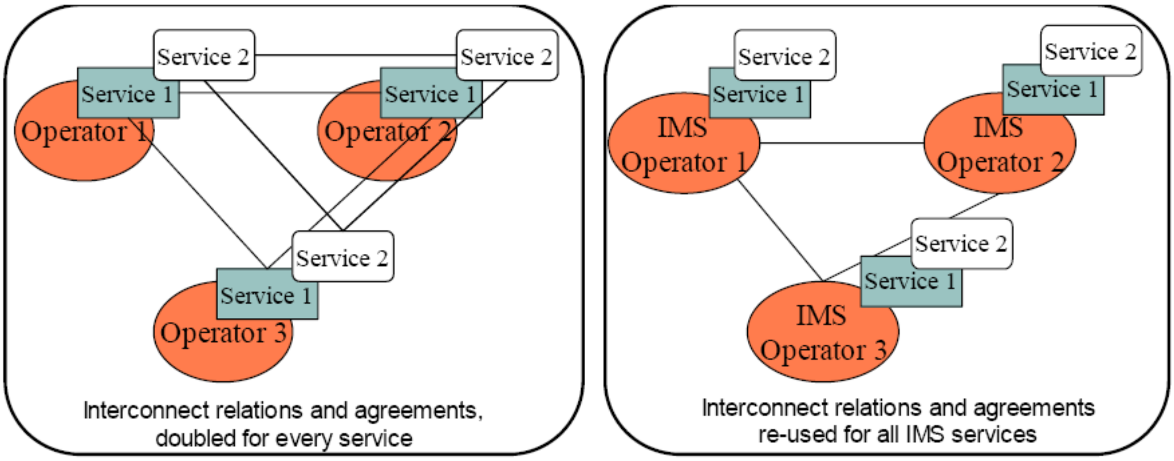

Fig. 2. The difference in service interoperability between a pre-IMS network and IMS enabled operators [2]

Architecture

The traditional vertical network structure – with its service-unique functionality for charging, presence, group and list management, routing and provisioning – is very costly and complex to build and maintain. Separate implementations of each layer must be built for every service in a pre-IMS network, and the structure is replicated across the network, from the terminal via the core network to the other user's terminal.

IMS provides for a number of common functions that are generic in their structure and implementation, and can be reused by virtually all services in the network. Examples of these common functions are group/list management, presence, provisioning, operation and management, directory, charging and deployment.

IMS offers a network architecture where software infrastructure, through the use of standards, enable network elements to look and feel like general purpose servers. With the 3GPP Release 5 and Release 6 specifications, IMS enables many network functionalities to be reused and shared across multiple access networks, allowing for rapid service creation and delivery. This opens the network for off-the-shelf application servers and IDE tools. The architecture consists of [1]:

1. Service Layer
2. Control Layer
3. Connectivity Layer

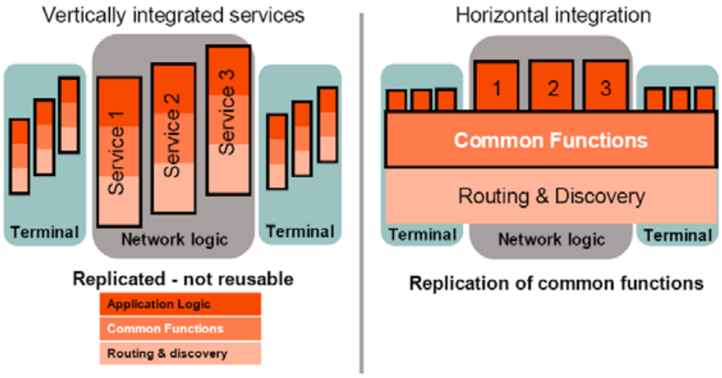

Fig. 3. How IMS enables the move from vertical 'stove-pipe' service implementations to a horizontally layered architecture with common functions [2].

Service Layer

IMS specifies a SIP-based common interface, IMS Service Control (ISC) by which applications hosted on SIP, Parlay/OSA and CAMEL application servers interact with the IMS core network. The main integration point between IMS application servers and the IMS core network is through the Serving Call Session Control Function (S-CSCF) network element. More detailed information on application servers will be given in the following sections.

Control Layer

Session control is where the network signaling is performed for setting up sessions. The session control layer consists of several core network elements which control and manage session set-up and maintain subscriber user data. Session control also provides interworking between IMS and PSTN/PLNM networks through media servers and gateways**.**

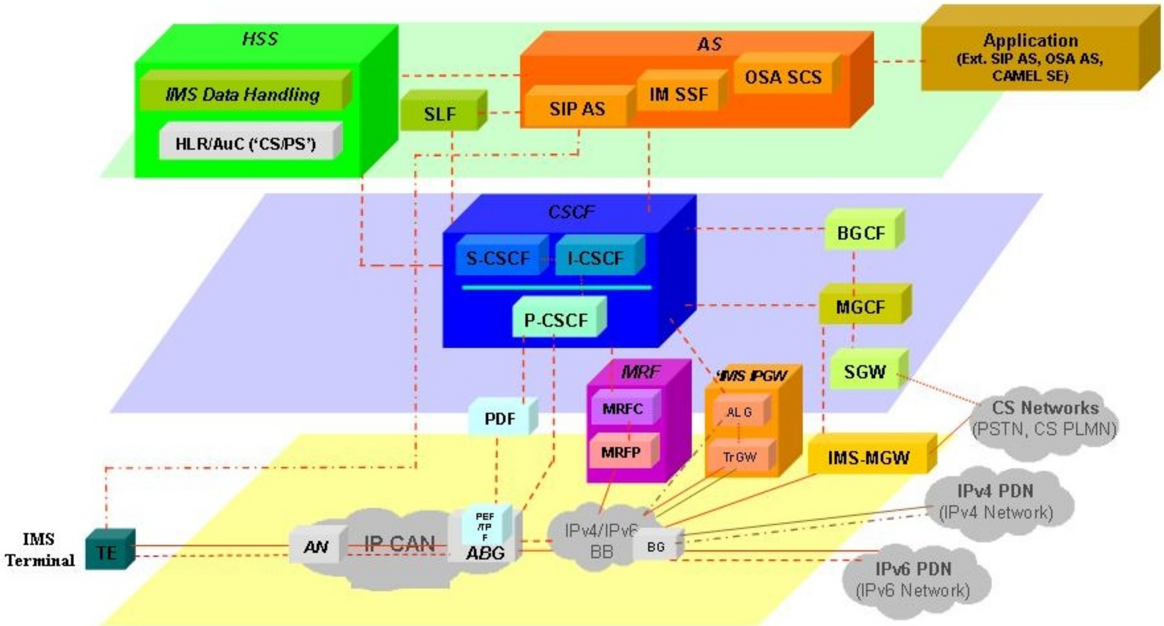

Fig. 4. Detailed view of IMS Architecture [5].

With IMS, users access personal services via a dynamically associated, usercentric, service-independent and standardized access point, the Call Session Control Function (CSCF). The CSCF is dynamically allocated to the user at log-on or when a request addressed to the user is received. Routing to the server is service-independent and standardized. The service architecture is user-centric and is highly scalable.

The CSCF is a SIP proxy and registrar server which manage the registration of IMS User Equipment (UE, also known as terminals, handsets, or SIP phones), and routing of SIP signaling messages to the appropriate IMS application server, or to the appropriate IMS or non-IMS network. Key to optimal SIP message processing by CSCF nodes, and service logic execution by IMS SIP application servers, are high-performance, high-availability features. The CSCF interworks with the transport and endpoint layer to guarantee QoS across all services. IMS specifies 3 different types of CSCFs[3]:

Proxy-CSCF (P-CSCF)

Performs SIP proxy server which routes SIP request and response messages of the UE to the Interrogating-CSCF(I-CSCF) determined using the home domain name as provided by the UE. It is the single point of entry for all traffic from the UE into the IMS network. It also sends all subsequent SIP messages received from the UE to the S-CSCF, whose name has been received as part of registration. P-CSCFs are typically located in the user's home network, but are often located in visited networks, and provides the following functionalities:

- Billing information generation
- SIP message compression for latency reduction to reduce the amount of data sent over the radio interface
- IPSec integrity protection for trusted messages
- SIP message verification

Interrogating-CSCF (I-CSCF)

SIP proxy server which queries the Home Subscriber Server (HSS) to obtain the address of the appropriate S-CSCF where the request must be forwarded, if no S-CSCF is currently assigned (e.g., unregistered subscriber), then assigns an S-CSCF to handle the SIP request. It is the first point of contact within the user's home network and routes SIP requests received from another network to the S-CSCF. I-CSCF provides the Topology Hiding Interworking Gateway (THIG) function.

Serving-CSCF (S-CSCF)

It acts like a SIP registrar server which enables the requesting user to access the network services provided by the network operator, and handles all of the SIP signaling between endpoints. The S-CSCF retrieves the subscriber profile from the HSS and interacts with Application Server platforms for the support of services. It also ensures that the media for a session, as indicated by SDP, are within boundaries of subscriber's profile. S-CSCFs are always located in the user's home network, and provides the following functionalities:

- Session control
- Service usage authentication & authorization
- Session context
- SIP message routing

Policy Decision Function (PDF)

PDF is responsible for making policy decisions based on session and media-related information obtained from the P-CSCF. It acts as policy decision point for Service-based Local Policy (SBLP) control. Some of policy decision point functionalities:

- To store session and media-related information
- The capability to enable the usage of an authorized bearer (e.g. PDP context)
- To inform P-CSCF when the bearer is lost or modified.
- To pass an IMS-charging identifier to the GGSN and to pass a GPRS-charging identifier to the P-CSCF

Home Subscriber Server

The session control layer includes the (HSS) element provides a central database which stores each subscriber's unique service preferences and information, including current registration information (IP address), roaming information, call forwarding information, etc.. IMS centralizes the subscriber information to enable multiple applications across multiple access networks to share and leverage any given subscriber's status and preference information. HSS also enables operators to better manage and administer subscriber data and provisioning across multiple services across multiple networks. HSS provides IMS service authentication and authorization support, as well as maintain information about the currently assigned S-CSCF for any given user request, and supports interactions with CSCFs and ASs.

***Subscription Locator Function* (SLF)** is used as resolution mechanism to find the address of the HSS that holds the subscriber data.

Transport Signalling Gateway Function (T-SGW)

This component serves as the PSTN/PLMN termination point for a defined network. Terminates, e.g. the call control signalling from GSTN mobile networks (typically ISDN) and maps call related signalling from/to PSTN/PLMN on an IP bearer and sends it to/from the MGCF.It also provides PSTN/PLMN IP transport level address mapping.

Roaming Signalling Gateway Function (R-SGW)

The role of the R-SGW concerns only roaming to/from 2G/R99 CS and the GPRS domain to/from the R5-6 UMTS tekeservices domain and the UMTS-GPRS domain and does-not involve the multimedia domain. We can summarize the main functions as [4];

- To ensure proper roaming, the R-SGW performs the signalling conversion at transport level (conversion: Sigtran SCTP/IP vs. SS7 MTP) between the legacy SS7 based transport of signalling and the IP-based transport of signalling. The R-SGW does not interpret the MAP/CAP messages but may have to interpret the underlying SCCP layer to ensure proper routing of the signalling.
- To support 2G/R99 CS terminals; we use R-SGW services to ensure transport interworking between the SS7 and the IP transport of MAP_E and MAP_G signalling interfaces with a 2G/R99 MSC/VLR[4].

Breakout Gateway Control Function (BGCF)

BGCF selects;

- The network in which PSTN breakout is to occur.
- A local MGCF or a peer BGCF.

Media Gateway Control Function (MGCF)

The MGCF serves as the PSTN/PLMN termination point for a defined network. Its defined functionality will satisfy the standard protocols/interfaces to [4]:

- Control parts of the calls state pertain to connection control for media channels in a MGW.
- Communicate with CSCF
- Select the CSCF depending on the routing number for incoming calls from legacy networks
- Perform protocol conversion between the legacy (e.g. ISUP, R1/R2, etc.) and the R00 network call control protocols
- May process out of band information such as DTMF signaling received in MGCF which it may forward to the CSCF or MGW.

Media Gateway Function (MGW)

The MGW serves as the PSTN/PLMN transport termination point for a defined network and UTRAN interfaces with the CN over Iu interface. It may terminate bearer channels from a switched circuit network (i.e. DSOs) and media streams from a packet network (e.g. RTP streams in IP network). Over Iu, the MGW may support media conversion, bearer control and payload processing (e.g. codec, echo canceller conference bridge) for support of different Iu options for CS services, AAL2/ATM based as well as RTP/UDP/IP based. The main functions can be summarized as [4];

- Interaction with MGCF, MSC server and GMSC server for resource control
- Ownership and resources handling, e.g. echo cancellers, etc.

- Ownership of codecs
- May detect events (i.e. bearer loss, DTMF digits, etc.) and notifies the MGCF.
- May perform DiffServ Code Point (DSCP) markings on the IP packets sent towards the UE

Multimedia Resource Function Controller (MRFC)

The MRFC performs;

- Controls the media stream resources in the MRFP.
- Interprets information from an AS via the S-CSCF (using SIP) and controls the MRFP accordingly.
- Communication with the CSCF for service validaation and for multiparty/multimedia sessions
- May be co-located with an AS to provide capabilities such as conference services.

Multimedia Resource Function Processor (MRFP)

Under the control of MRFC the functions of MRFP can be summarized as:

- Mixes (e.g. for multiple parties), sources (for multimedia announcements) and processes (e.g. audio transcoding) media streams.
- Performs bearer control (with GGSN and MGW) in cases of multiparty/multimedia conferencing
- Provide tones and supports DTMF within the bearer path.
- Notifies the MRFC when an event has occurred such as DTMF digit collection.

MSC and Gateway MSC Server

The MSC server includes mainly the call control and mobility control parts of a GSM/UMTS MSC. It has responsibility for the control of MO and MT 04.08CC CS domain calls. It terminates the user-network signalling (04.08 + CC + MM) and translates it into the relevant network-network signalling. The MSC server also contains VLR to hold the mobile subscriber's service data and CAMEL-related data, controls the parts of the call state that pertain to connection control for media channels in an MGW [4].

The GMSC server comprises primarily the call control and mobility control parts of a GSM/UMTS GMCS. An MSC server and an MGW make up the full functionality of an MSC, while the Gateway MSC and a GMSC server and an MGW make up the full functionality of a GMSC.

Connectivity Layer

The network connectivity layer consists of routers, switches, media servers and media gateways for converting VoIP bearer streams to the PSTN TDM format. This layer provides a common pool of media servers which can be shared across multiple applications and services including conferencing, playing announcements, collecting in-band signaling tones, speech recognition, speech synthesis, etc. This layer also initiates and terminates SIP signaling to set up sessions and provide bearer services such as conversion of voice from analog or digital formats to IP packets using Realtime Transport Protocol (RTP). The IMS network architecture supports connectivity with all types of access networks, whether it's IP, broadband/DSL/cable, Wi-Fi, circuit-switched mobile, packetswitched mobile, legacy mobile, or external IMS networks.

Application Server Layer

The application server layer contains the application servers, which provide the end-user service logic. The IMS architecture and SIP signaling is flexible enough to support a variety of telephony and non-telephony application servers. For example, SIP standards have been developed for telephony services and IM services.

Telephony Application Server

The IMS architecture supports multiple application servers for telephony services. The Telephony Application Server (TAS) is a back-to-back SIP user agent that maintains the call state. The TAS contains the service logic which provides the basic call processing services including digit analysis, routing, call setup, call waiting, call forwarding, conferencing, etc. The TAS provides the service logic for invoking the media servers to support the appropriate call progress tones and announcements. If the calls are originating or terminating on the PSTN, the TAS provides the SIP signaling to the MGCF to instruct the media gateways to convert the PSTN TDM voice bit stream to an IP RTP stream and to direct it to the IP address of the corresponding IP phone.

As part of executing the telephony call model, the TAS provides the Advanced Intelligent Network (AIN) call trigger points. When a call progresses to a trigger point, the TAS suspends call processing and checks the subscriber profile to determine if additional services should be applied to the call at this time. The subscriber profile identifies which application servers should be invoked. The TAS formats a SIP IP Multimedia Service Control (ISC) message and passes call control to the appropriate application server. This mechanism can be used to invoke legacy AIN services or to invoke new SIP based applications servers. A single IMS can contain multiple TASs that provide specific features to certain types of endpoints. For example, one TAS might provide the IP Centrex business features (i.e., private dialing plans, shared directory numbers, multiple call appearances, Automatic Call Distribution (ACD), attendant services, etc.). Another TAS might support PBXs and provide advanced Virtual Private Network (VPN) services. The multiple application servers can interwork using SIP-I signaling to complete calls between the different classes of endpoints.

Supplemental Telephony Application Servers

The application server layer can also contain stand-alone independent servers that provide supplemental telephony services at the beginning of a call, at the end, or in the middle, via triggers. These services include click to dial, click to transfer, click to conference, voice mail services, VoIP VPN services, prepaid billing services, and inbound/outbound call blocking services.

Non Telephony Application Servers

The application server layer can also contain SIP based application servers that operate outside of the telephony call model. These application servers can interwork with endpoint clients to provide services such as IM and presence-enabled services. By implementing these non-telephony SIP based services in a common IMS architecture it is possible to interwork telephony and non-telephony services to create new blended communication services. One example of such blended service is a converged click-to-contact buddy list that displays end user’s presence and availability information, and provides a point and click interface across multiple communication services (telephony, IM and PTT). Another example is the use of a single pre-paid services account for telephony and VoD services.

Application Server Details

IMS Service Invocation and Interaction

At S-CSCFs, there are service triggers on initial SIP requests. Upon meeting the criteria, Service Proxy proxies the request to the correspondent application server based on triggers and filter. Applications servers can act as user agents, proxy servers or back-to-back user agents. Application server may decide to stay in signaling path by Record-Routing the SIP request. Service Proxy maintains the states between dialogues sent to applications or sent from applications.

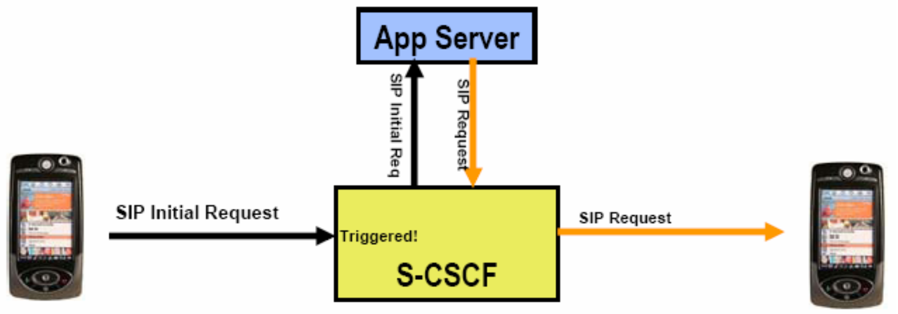

Fig. 5. A simple model depicting the service triggers [9]

How a SIP Application Server Provides Enhanced Services

By filtering, which can be based on calling/called party or other mechanism, S-CSCF determines that a call requires enhanced service processing or not. The filtering criteria are defined based on SIP message type, header fields, etc. Utilizing these criteria, the S-CSCF also determines the address of the application server and relays the call to the relevant application server function. Later, the application server receives the call and invokes the appropriate service logic. The service logic then either redirects the call to a new destination or send the call back through the S-CSCF in order to monitor subsequent call events, i.e., it acts as a proxy server.

Service Platform Interfaces

The important service platform interfaces are Cx, Dx and Sh. Cx interface is used to transfer information between S-CSCF and HSS. It is used to exchange location information, to authorize a user to access the IMS, to exchange authentication information and to download and handle changes in the user data stored in the server. Dx interface is between the I-CSCF and Subscription Locator Function (SLF). The HSS look-up becomes necessary, through SLF, when the operator has deployed multiple HSS's in the network. The Sh interface, is the interface between HSS and applications server, which allows to download and update transparent and non-transparent user data and to request and send notifications on changes on user data.

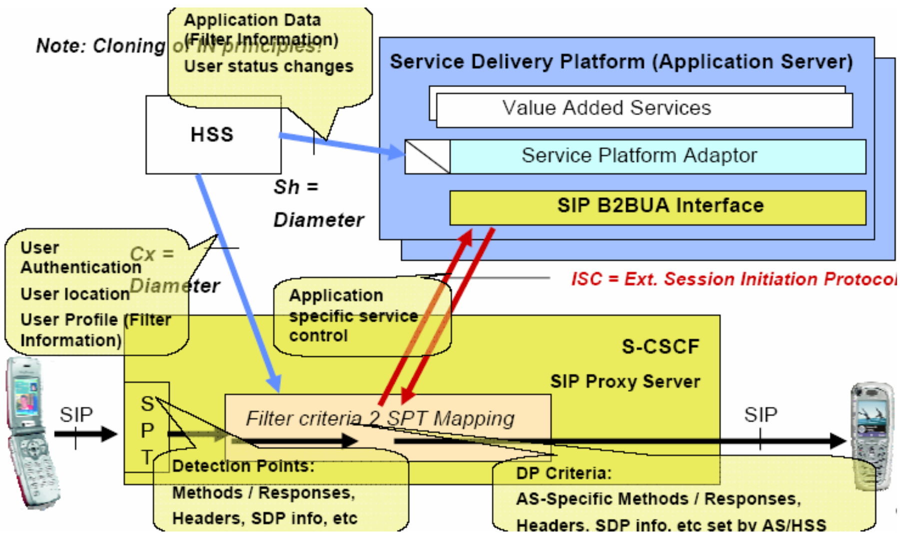

Fig. 6. The diagram showing the places of the important interfaces [9]

IMS Filter Criteria

The contents of the IMS Filter Criteria (IFC) are Trigger Point and Service/Application Server Identifier. Trigger point contains one or more Service Triggers which are linked via the logical expressions, like AND, OR, NOT, EQUAL. The Service Trigger includes Request URI content, SIP Method (e.g. INVITE, REGISTER), SIP Header content, Session Mode (originating, terminating) and SDP content. Application server identifier is in the SIP URI format, e.g., sip:as1@as.operator.com. The IMS Initial Filter Criteria (IFC) is the key point for service provisioning in IMS. The S-CSCF downloads the IFC for a particular user from HSS and has the ability to forward SIP messages to an appropriate Applications Server (SIP AS, OSA SCS and IM-SSF). Application server application/service invocation is triggered as a result of a pattern matching on any SIP header or body.

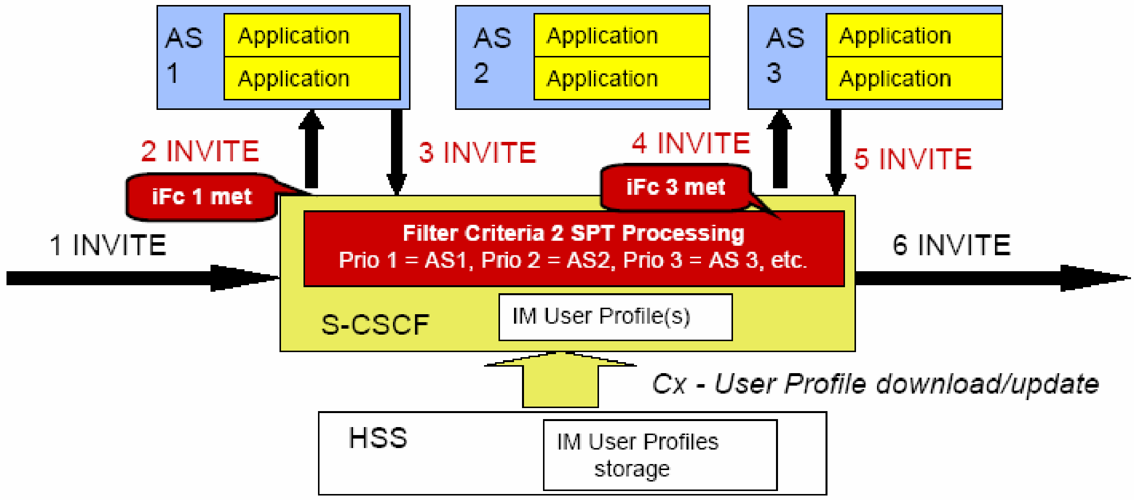

Fig. 7. Checking the criteria and taking care of the matched ones in order of priority [7]

IMS Application Server Options

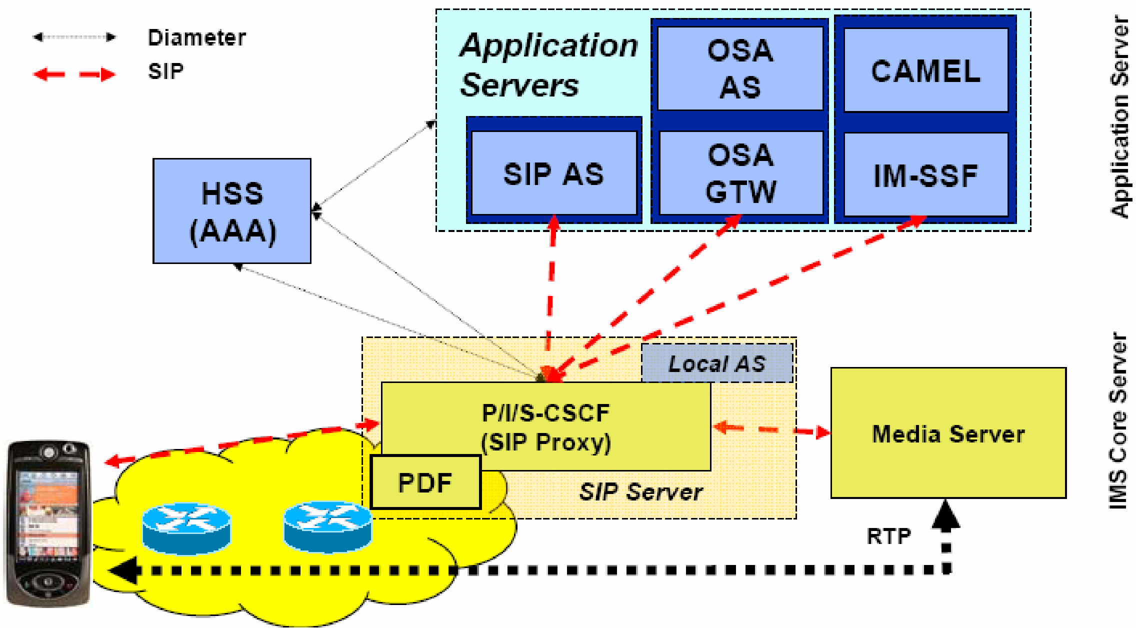

Fig. 8. Application Server options in the IMS system [9]

• **IMS services on SIP-Application Server:**
– intended for new services. A multitude of widely known APIs (CGI, CPL, SIP Servlets) is available.

• **IMS services directly on the CSCF (similar to SIP AS):**
– SIP-AS co-located on the CSCF
– Seems to be useful for simple services. May be beneficial for the Service Availability and the Service Performance.
• **CAMEL Services via Camel Support Environment (CSE):**
– Intended for the support of existing IN Services (provides service continuation).
• **OSA Services via Open Service Access Service Capability Server:**
– Intended for the support of 3rd Party Application Providers. OSA SCS provides access and resource control.

SIP Application Server (Servlets)

The architectural diagram of the SIP Application Server is shown in the following figure:

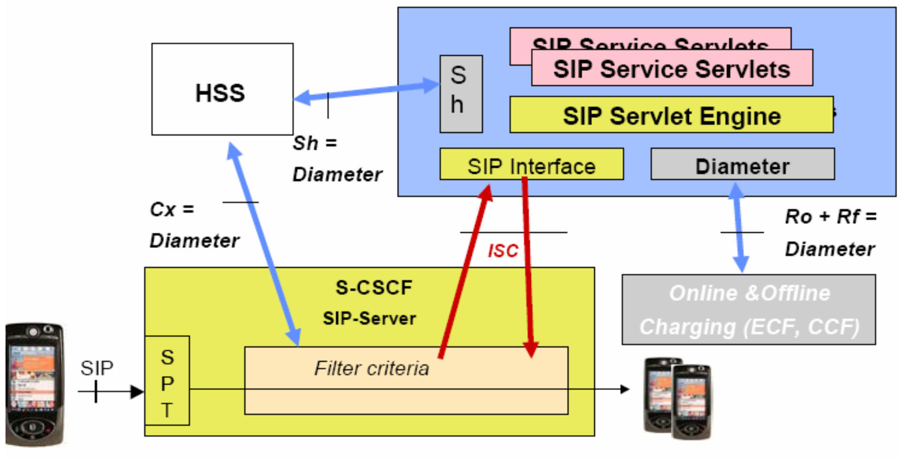

Fig. 9. The SIP Application Server in the IMS architecture [9]

CAMEL Reuse within IMS

Customized Applications for Mobile Networks Enhanced Logic (CAMEL) services can be reused in the IMS architecture through utilization of the IP Multimedia – Services Switching Function (IM-SSF). The IM-SSF provides the interworking of the SIP message to the corresponding CAMEL, ANSI-41, Intelligent Network Application Protocol (INAP) or Transaction Capabilities Application Part (TCAP) messages. This interworking allows the IP Phones supported by IMS to access services such as calling name services, 800 services, Local Number Portability (LNP) services, one number services, and more. The architecture of the IM-SSF and the other components are shown in the following figure.

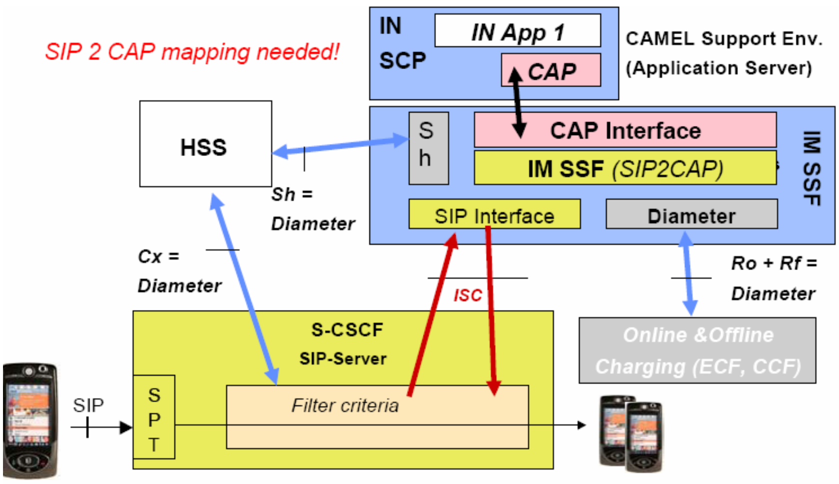

Fig. 10. Structure of the IM SSF [9]

Open Service Access – Gateway (OSA-GW)

The IMS architecture allows service providers the flexibility to add services into their VoIP networks by interacting with legacy applications or by integrating SIP-based application servers that they purchase or develop themselves. In addition, service providers want to allow their customers to develop and implement services that leverage the VoIP network resources. For example, an enterprise may want to voice-enable or IM-enable some back office operations to automatically initiate a call or an IM if an order is about to be delivered. This could be triggered by the location information of a wireless PDA carried by the delivery person. However, frequently the enterprise application developers have IT backgrounds and are not familiar with the variety of complex telephony signaling protocols (i.e., SS7, ANSI41, CAMEL, SIP, ISDN, etc.). To provide a simple API for communications services, the Parlay Forum, working closely with the 3GPP and ETSI standards development organizations, have jointly defined a Parlay API for telephony networks. The interworking between SIP and the Parlay API is provided in the Open Services Access – Gateway (OSA-GW) that is part of the application server layer of the 3GPP IMS architecture. As described, other applications servers provide the interworking between SIP and the telephony protocols (ANSI-41, CAMEL, INAP, TCAP, ISUP, etc.). The OSA-GW allows the enterprise-based Parlay applications to access presence and call state information, set up and tear down sessions, and to manipulate legs of a call. The OSA-GW implements the Parlay Framework, which allows the enterprise applications servers to register with the network and manage access to network resources. The following figure shows the architecture just described.

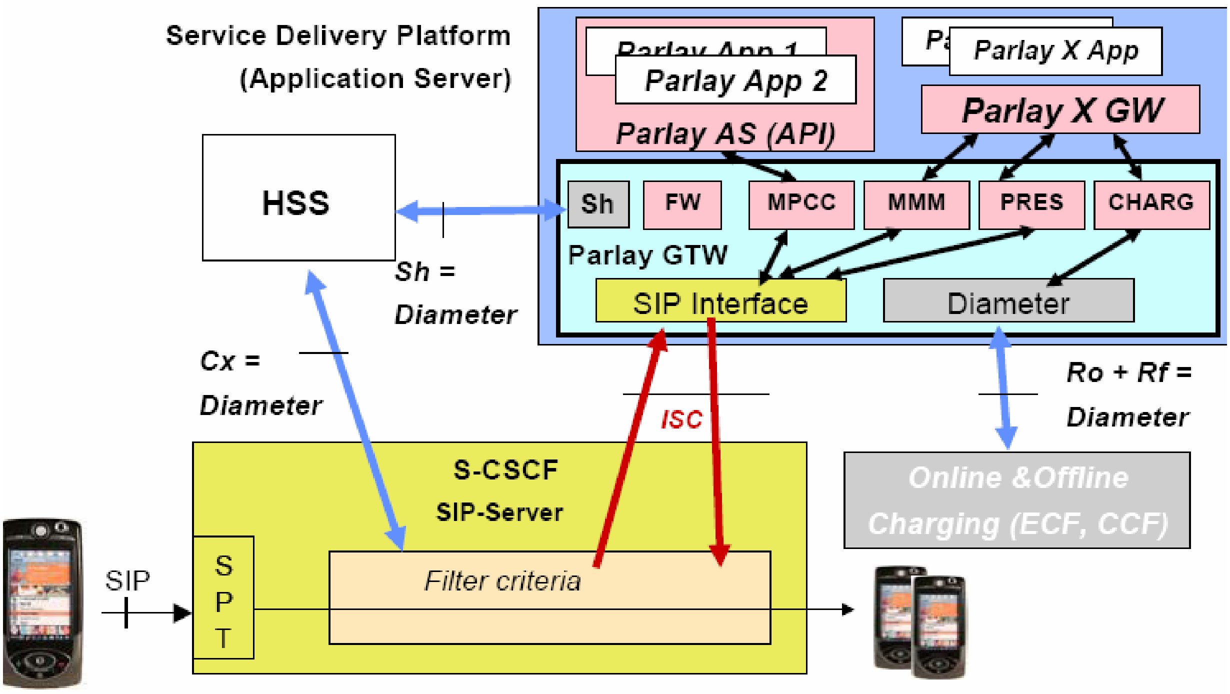

Fig. 11. Open Service Access/Parlay [9]

Final step –Putting it all together [SIP AS vs. CAMEL vs. OSA/Parlay]

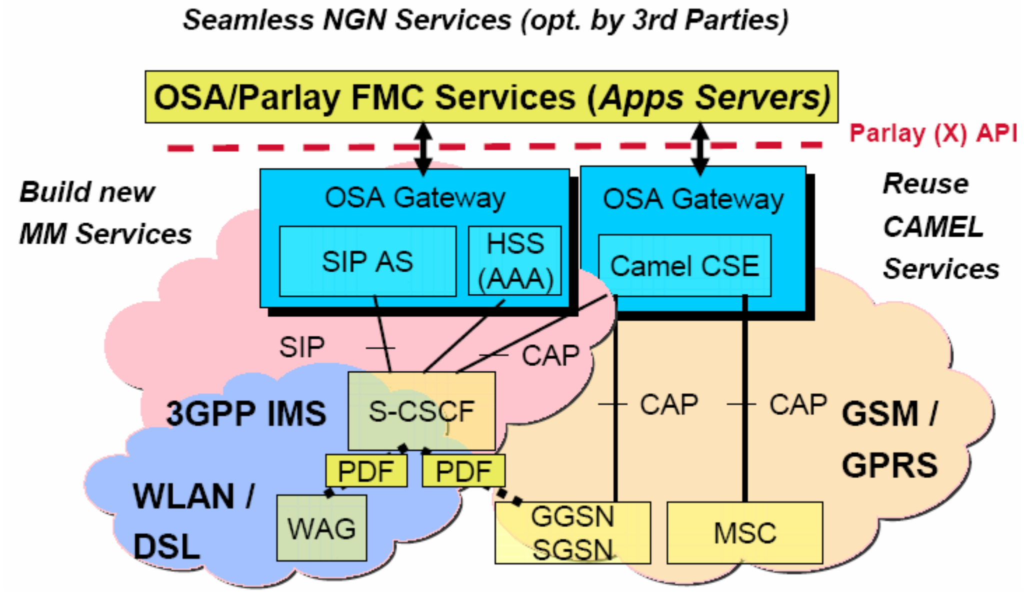

Fig. 12. Depicting all types of application servers [9]

As described, CAMEL provides legacy intelligent network services in 2G and 3G networks. The services are based on proven and reliable IN technology, but, they are expensive and limited in evolution. On the other hand, SIP application servers provide multimedia conferencing services and they are integrated with HTTP. They exploit the Internet technology with is cheaper and also, the service creation is easier. But, SIP application servers are not yet proven for carrier grade services. Open Service Access is an API which could be mapped to both CAMEL and SIP. It's a proven technology which reuses existing services in NGN. It is THE method of choice for supporting 3rd party application servers.

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