# An enabler gateway for service composition using SIP

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***Abstract*—To deliver the advanced services in IP Multimedia subsystem (IMS), composition of many services is needed. However, IMS standard does not specify properly the architecture for the Session Initial Protocol (SIP) based service composition. Better performance and different user experience can be achieved in the SIP service composition for the real time communication services. We propose modified IMS architecture by adding new functional entities: Service Enabler Gateway and Application Server (AS) for the SIP based service composition. Java Specification Request (JSR) 289 AS is chosen for this and initial work has been done for service discovery for IMS services**.

***Keywords- IP Multimedia subsystem, Service composition, SIP***

## I. Introduction

The Third Generation Partnership Project (3GPP) has proposed the IP Multimedia Subsystem (IMS) service architecture for the next generation networks in order to provide many multimedia services. 3GPP service architecture is designed in a way to reduce the complexity and increase the reuse by defining the basic service building block. These service building blocks are called as service enabler by Open Mobile Alliance (OMA). OMA effort on standardization of service enablers has been progressed [1].

Service Composition is a combination of a set of services for achieving a certain purpose [15]. We inherit two terms from service composition definition: session orchestration and service blending. Session orchestration is referred as combination of set of Session Initial Protocol (SIP) services only in a single session for a achieving a certain purpose. Session blending is considered as combination of a set of SIP and Web services for achieving a certain purpose in a single session. Service composition is needed to provide the advanced services to a user. For example, the user needs to treat the session using the dynamic data such as presence information, location information, etc. This is not possible with existing initial filter criteria (iFC) in Serving-Call Session Control Function (S-CSCF). Moreover, users are now motivated to use individual service space where all needed services can be composed and aggregated. For example, iGoogle provides the support to aggregate all the Really Simple Syndication (RSS) feed services. In Service Platform for Innovative Communication Environment (SPICE) [14], users can create own services using service creation environment. SPICE supports only Web service composition. However, IMS service architecture is not flexible to address this problem, because it does not have proper service architecture for SIP service composition.

We investigate the problem and propose service architecture for SIP service composition in IMS. The main contribution of this paper is that IMS architecture is proposed to support the session orchestration and service blending. This architecture is designed in a way that third party service providers also perform session orchestration and service blending.

In this paper, we present the proposed architecture in Section II. Then in Section III, we present the different orchestration models in Java Specification Request (JSR) 289 AS. The Section IV has information about authorization when AS interacts with service enablers and presents the service discovery in IMS service architecture. The related work is presented in Section V. At last, we present conclusions and future work.

## II. Proposed Architecture

### *A.Requirements*

The proposed architecture takes into account three actors: user, service provider and network provider. Service provider gives services using session orchestration/service blending and can be external to a network provider. Network provider implements the IMS and all the service enablers. When service provider and network providers are different, this connectivity should ensure the interest of both parties. Efficient mechanism should be developed for service provider in order to implement the session orchestration and service blending. In addition, one more requirement is service discovery for SIP/IMS services which is very much needed for dynamic service composition.

### *B.Solution*

The figure 1 shows proposed architecture which is mainly focusing on four functional elements. Detailed description of the four functional elements in the proposition is given below. Main strength of this architecture is that unique functional entity is defined only for session orchestration and service blending.

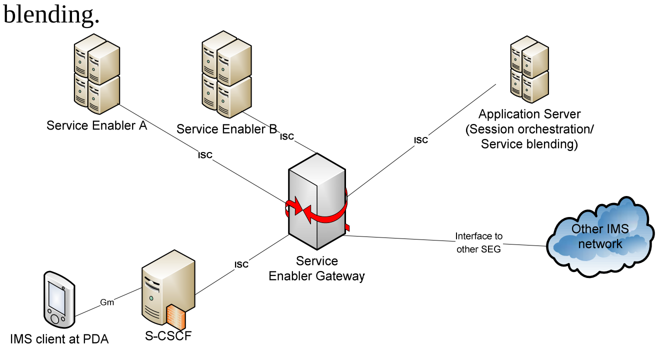


Figure 1. The proposed architecture for SIP based composition in IMS

1) S-CSCF: As defined in 3GPP standards.
2) Service Enabler Gateway (SEG): New functional element implements following logical functions.
   a) Implementing the policy for session orchestration in the network provider side. Policy based solution authorize the SIP request to/from Application Server (AS). Based on authorization, SIP request will be routed to the destination.
   b) SIP messages between composed application and service enablers which are in different IMS domains can be routed between two SEGs to have an optimum routing instead of passing many SIP proxies (e.g., S-CSCF, Interrogating(I)-CSCF, Proxy(P)-CSCF).
   c) Topology Hiding Internetworking Gateway (THIG) feature will be implemented in SEG, because SIP messages are sent via trust domains and un-trust domains.
   d) A centralized solution for service repository and service discovery is implemented in SEG. Dynamic service composition at SIP level uses discovery services.
   e) The policy for security, charging and logging can be implemented in SEG in future as Policy enforcer behaves in OMA service environment. More information of authorization and service discovery is presented in Section IV respectively.
3) AS for session orchestration and service blending:
   Session orchestration is the preliminary requirement, satisfied by AS. In addition, AS should support the service blending at least using SIP and Web services.
   JSR 289 SIP AS [4] satisfies the above requirements and can be placed in service provider side. Session orchestration is implemented in the Application Router (AR) of the JSR 289 AS. JSR 289 AS explicitly avoids implementing the specific orchestration model [2], which depends on different use cases. This decision gives much flexibility for the service developer. Details about the different orchestration models and how it fits into telecom needs are discussed in Section III. Implementing different orchestration model for the AR will not effect over all architecture. Service blending can be done within the SIP application of the JSR 289 AS.
   Moreover, E-Chart for SIP Servlet is an enhanced Unified Modeling Language (UML) state chart and can be used for developing the SIP services in SIP Servlet using Graphical User Interface (GUI) interface [3]. UML state chart is the best choice for implementing real time communication services, because these are asynchronous and event based services.
   Importantly, the cooperation and interoperability between services are ensured in the service logic of the AR by the service developer. It means that conflict detection and resolution is handled by the orchestration model, which is implemented in the AR.
4) Service enabler: As defined in 3GPP and OMA.
   Interfaces to SEG from service enablers, S-CSCF, and AS are IMS Servic Control (ISC). An interface between AS and SEG is Secure Socket Layer (SSL) enabled. IMS client usually interacts with S-CSCF via P-CSCF. The *Gm* and *Mw* interface are used between IMS client and S-CSCF. This information is not shown in the figure 1. Interface between SEG is not defined.

## III. Orchestration Models for the Application Router in JSR 289

JSR 289 AS consists of AR, container and SIP applications. The AR helps the container where to route the SIP messages and will play crucial role in managing the service interaction. Managing the service interaction is called as orchestration model, which depends on use cases. Therefore, JSR 289 AS avoids implementing the particular AR. In addition, JSR 289 AS can be placed in either network provider premises or service provider premises based on the situation. This section discusses different orchestration models for JSR 289 AR and explains how it can fit into the IMS service environment.

### *A. Distributed Features Composition (DFC)*

DFC is used in Public Switched Telephone Network (PSTN) service composition by AT&T. This composition model works well when constituent services change call by call basis or session by session. DFC makes a decision to compose the different services based on information of region, subscriber identity, and application influence on the selection process of the AR [2]. In contrast, Web service composition only considers the compatibility of the services.

DFC mechanism is very simple and easy to use compared to on-line mechanism proposed in [5].

When information, such as subscriber identity, region information and directive, passes between AR and SIP application, object oriented technique is used in DFC implementation. In many situations, AR and SIP application can be located in different containers. Therefore, it is advisable to include this information within the SIP message. Wider understanding among SIP community is needed to include SIP headers for region, identity, and directive information.

According to JSR 289 AS design, JSR 289 AR is not in the application path and does not know any response going through. However, all the invoked services establish the application path and subsequently they receive all the messages within a session. DFC has inefficiency to implement a use case which invokes different services at different events.

In addition, DFC algorithm fairly works well for all the Voice over IP (VoIP) related services composition. This AR can be placed with S-CSCF in the network provider side to implement VoIP services. IMS is developed for delivering the vast array of multimedia services to a user. Therefore, enhancing the capability of the DFC based orchestration model for chaining the different services in different situation is important.

*B. Finite State Machine(FSM)*

FSM is another orchestration model for the AR. Communication services are based on events. The event based language is easy and flexible for composing the real time services [6]. To invoke the services efficiently based on the events, AR should implement finite state machine. State Chart Exchangeable Markup Language (SCXML) is an existing solution based on finite state machine to implement the service composition based on event. Some use cases benefit from the finite state machine based AR which composes different services according to the event. For example, when user starts or changes the IP-TV channel, composed service automatically publish the detail of the TV channel to the presence server [7]. Please note that this use case can be implemented with a help of DFC.

*C. Business Process Execution Language(BPEL)*

BPEL is a specification and modeling language used in Web services composition and well known to large base of service developer. This subsection is devoted for analyzing the relevance of BPEL for the AR in the context of the SIP service composition. Event based orchestration model is explicitly correlates with a session and can be flexible enough to compose the SIP services. In contrast, BPEL is a process driven language and does not explicitly support for the events. Given that Web Services for Business Process Execution Language (WS-BPEL) 2.0 has following constructs: Assign, Receive, Reply, Invoke, Wait, Empty, Sequence, Flow, While, Switch, Scope, and Throw [8], sequence and flow are interested to SIP level composition. The sequence specifies the predefined sequence logic and flow is used to specify the parallel logic. In telecom context, executing the sequence logic is better addressed in iFC and DFC than BPEL. iFC makes the sequence based on priority order dynamically. DFC allows the service developer to set the order based on routing region, application influence and user identity. In fact, if use case has static sequence logic invocation at SIP level, BPEL orchestration model would be ideal. However, iFC and DFC are lacking the flow or parallel logic invocation. Even though, BPEL is developed for the Web service composition, it could be used session orchestration situation slightly as it explained before. Therefore, Sequence and Flow construct make BPEL as a candidate orchestration model for the AR in JSR 289.

## IV. FEATURES OF A SERVICE ENABLERS GATEWAY

The SEG implements two important features such as authorization and service discovery discussed in this section.

*A. Authorization*

The network provider needs to authorize the AS by which many service enablers can be accessed.

The new functional element - service enabler gateway routes the message from/to AS based on authorization policy. The agreement between the network provider and service provider specifies that what service enabler can be accessed by AS. As a result, optimum SIP message routing can be performed in SEG.

Policy based Authorization is implemented in SEG for each SIP request. SIP headers are used to form the condition of policy. Simple schema for authorization policy contains of conditions, actions, and destination-transformation clause.

Authorization process does not semantic of a SIP session such as create new SIP request (new SIP dialog, part of existing dialog, and standalone transaction) and forwards same request.

*B.Service Discovery*

Discovery service is needed in the IMS service architecture to support the dynamic service composition at SIP level. Let assume that service composition logic can be described in template with constraints. Constituent services can be described using high level description in the service composition logic. Composition engine can bind the right services with a help of discovery services. Therefore, inventing the discovery services is important for IMS service architecture. In addition, description of SIP services and their relationship are major hurdles for SIP based service composition and SIP based conflict resolution.

Until IMS Release 8, this feature is not addressed in the 3GPP or OMA standard and there are some propriety solutions. In the meantime, 3GPP has started to give unique identification for the IMS communication service [9]. This 3GPP work can be considered as preliminary and can be a base to extend description of the IMS communication services.

Additionally, IMS service modeling is proposed in [1]. User perception, technical function and associated service enablers are linked to the IMS service model. It is fairly an acceptable model for real time services at the service level.

To provide service discovery, the centralized entity called as “service repository” is proposed. This central repository approach is more favorable in this situation. Because many request will come from the AS. Therefore, it will also ease the administrative issues such as applying authorization, etc. Also Discovery service can be developed as separate service enabler or combine with SEG. However for the convenience, discovery service is implemented with SEG.

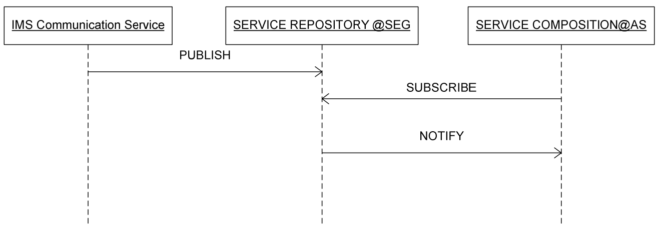


Figure 2: Sequence chart in service publishing and service discovery

The proposed discovery service uses SIP event framework for transporting the information between entities. SIP event framework consists of SUBSCRIBE, PUBLISH and NOTIFY messages. Service provider (resources side) will PUBLISH the information to the services repository. The published information from the resources is stored in a repository which provides the information for SUBSCRIBE request comes from an application. The sequence chart corresponding to messaging for service discovery is shown in figure 2. Interoperability in SIP event framework is very high.

In future, SIP services can be described semantically. SIP based communication services rely on many other parameters such as Quality of Service (QoS), and charging. Therefore, applying the Semantic Web technology to service description is useful for searching the services and adopting the services. In this situation, SIP event framework is flexible. Because event specific body in SIP messages carries any queries of the request. If services are described using Web Ontology Language for Services (OWL-S), request can send the queries based on OWL-QL (Query Language).

SIP service is described along with IMS service model [1], which considers the IMS services at the service level. Complete service description for IMS services need to go long way.

Explanation with an example: Let assume there is a location service in IMS service delivery platform. Location services will publish the information (functional and non-functional, binding information) of its services to discovery services located in SEG. On the other hand, consumer makes a request using SUBSCRIBE message with a criteria. Response is a NOTIFY message.

There are some limitations with the proposed service discovery. Important one is that current SIP event framework will need extensions to support the discovery services. This also needs wider understanding among the SIP/IMS community. Another problem is authorization of service discovery access. Authorization policy for service discovery request can be designed and stored in SEG.

## V. Related Work

Some researchers [10] emphasis that orchestration and policy control is common for IT and telecom. They also explained what is service orchestration and session orchestration. More focus is given how it is achieved in OMA service environment. Importance of separating the orchestration and policy control is demonstrated with help of OSE. It does not show how it could be achieved for orchestration and policy control at session level. In this proposed architecture, session orchestration and policy are separated. Some work has been done to consolidate the concepts of Service Capability Interaction Manager (SCIM) [11]. However they failed to say that what SCIM does whether orchestration or policy control or both. In our proposed solution, AS is used for session orchestration or combination of session and service orchestration. Policy control is placed in SEG. As suggested in [12], IMS service interaction management may be improved through enhancements of the IMS service control interface and iFCs. This solution will play the role in the network provider side and not provide much flexibility to compose many services, and still consider the voice related services.

In last, JSR 289 is designed for SIP services composition and does not mentioned how it can be integrated with IMS [4].

## VI. Conclusion

We have presented a top-down view of the service composition at SIP level in the IMS service architecture. We have identified the different roles involved in a service composition and their requirements. The proposed architecture is a complete solution covering all the requirements of the user, network provider and service provider. For service provider, SIP session orchestration can be done by defining the AR and service blending can be done within the applications in JSR 289 AS. The composed service can be delivered to user via IMS/SIP or HTTP. Moreover, finer granularities of the SIP services are sustained.

A new functional entity has introduced in this proposal called as SEG. Authorization of SIP request from/to AS is carried out in this functional element. Apart from this, we have explored the discovery service for IMS services and interconnection with another IMS network via SEG. SEG can include these two logical functions.

The verification of this concept totally depends on development of this system which will take significant time on developing the SEG and composed application in JSR 289. In addition, performance improvement and finishing the partial work on service discovery are remaining to finish fully.

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