SCIM (Service Capability Interaction Manager) Implementation Issues in IMS Service Architecture

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Abstract

Reusing service capabilities to implement different integrated services in Next Generation networks (NGN) provides flexible and open service architecture capable of creating innovative services that do not need to be standardized and are based on the standardized service capabilities. In this architecture, invoking each integrated service may provoke the invocation of multiple service capabilities. The service architecture must therefore provide a mechanism to manage the interactions and the incompatibilities that may occur between these service capability invocations. Due to the shortcomings in the NGN service architecture domain for defining such mechanisms, we define in this paper, new architectural concepts regarding the implementation of a service capability interaction manager as well as the functionalities that this new entity must provide to avoid conflicts between service capability interactions in order to implement integrated services based on the standardized service capabilities.

1 Introduction

The communication services are moving from PSTN/GSM telephony and/or email to multiple communication services: chat, instant messaging, voice, video, presence, address book, TV broadcasting… If all these services are deployed in an uncoordinated way by a service provider, the user himself will have to handle the interactions between the services (e.g. by publishing his availability information for several services). In addition, advanced functionalities between these services (like routing voice calls according to the availability state) are not possible in this case. The answer to improve the user experience is to build an environment of integrated services that enables the reuse of the user information between services, the ability to integrate easily new services and the service continuity from any access network and any terminal.

Such evolutions introduce the need for defining flexible service architecture for the NGN. Wireless Work Research Forum (WWRF) Working Group 2 (WG2) developed the "I"-centric paradigm to relieve the user of technological related decisions by defining a service infrastructure model containing general service capabilities such as ambient awareness, personalization and adaptability [15].

Composing the service layer of the NGN by modular building blocks offers Service Providers the ability to create, implement and manage new services that integrate these building blocks in a rapid and efficient way. In the context of the NGN standardization at 3GPP (Third Generation Partnership Project), these modular building blocks are called service capabilities and are defined as self-contained functionalities that can be reused across different application servers [11]. These reusable constituent elements of an application server are standardized and enable the service level interworking. Indeed, instead of standardizing new services, NGN standardization at the service layer focuses on service capabilities. Reusing existing service capabilities will prevent the redundant use of the same functionalities implemented in many services, avoiding multiple interactions with network entities.

Providing the ability to integrate different service capabilities requires a mechanism to manage the eventual interactions that occur between service capabilities. Service capability interactions occur when each of the service capabilities behaves correctly separately i.e. independent of each other, but not when running together. In the service architecture of IMS (IP Multimedia Subsystem) [2], the specifications of 3GPP [1, 2] propose a SIP (Session Initiation Protocol) [8] application server called Service Capability Interaction Manager (SCIM) to control the conflicts and the interactions between services. But the specifications do not specify precisely the functionalities of SCIM, i.e. the way it should coordinate multiple invocations of the service capabilities and the way that it should

handle the incompatibilities between service capability invocations.
In the first part of this paper we present how common service capabilities such as Presence, Instant Messaging and Conference service capabilities can be used as the basic building blocks to implement integrated services like Multimedia Gaming and Multimedia Messaging. In the second part we propose new architectural choices for implementing SCIM and we define the functionalities that should be performed by SCIM to control the service capability invocations and to manage the interactions between them.

2 Integrating Service Capabilities to implement Application Servers

The service architecture specified by 3GPP is designed so that these new services can reuse the standardized common service capabilities. [13] remarks the commercial and technical advantages of standardization of the Presence service capability as a building block to implement multiple presence enabled services. Other service capabilities that we will review in this part such as Messaging and Conference service capabilities can also be used as the building blocks to implement integrated services such as Multimedia Gaming and Multimedia Messaging, as well as other ad hoc multimedia services such as e-commerce, e-learning and telemedicine.

2.1 Service Capability

In the IMS [1], specified by 3GPP for enabling a standard IP-based service creation and delivery platform for providing multimedia services in NGN, Application Servers are invoked through SIP proxies called S-CSCF (Serving-Call Session Control Function) [2]. SIP is standardized by IETF (Internet Engineering Task Force) and is selected by 3GPP as the signalling protocol for establishing, controlling and terminating multimedia sessions. As it is illustrated in Figure 1, S-CSCF communicates with Application Servers via a SIP based IP multimedia Service Control (ISC) interface. AS and S-CSCF communicate also with HSS (Home Subscriber Server), which is the central database for service and network.

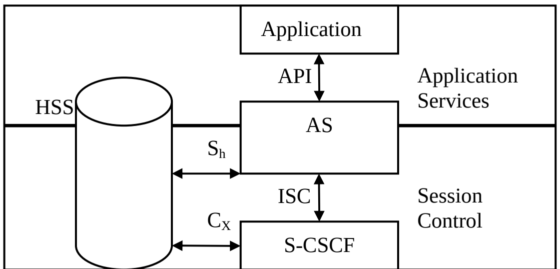

Figure 1 : IMS Service Architecture

In this part we present the functionalities of the Presence, Messaging and Conference Services as service capabilities used in multiple multimedia services and then we present the combination and integration of these service capabilities in application services such as Multimedia Gaming and Multimedia Messaging services in order to enable interworking at the service level and to provide an open and service-capability based service architecture allowing efficient creation and implementation of new services without needing to reintroduce service building blocks that are already present in the service architecture. Therefore the advantage of this integration in the standardized architectures is that the service capabilities that are offered by dedicated application servers can be reused by different application servers to implement the integrated services.

2.1.1 Presence Service Capability

Presence Service capability [3] manages the presence and availability of entities (subscribers, Application Servers…), called presentities. Presence information of presentities is represented in the form of presence tuple, that may convey user's communication means status, service type (Telephony, SMS, email, Multimedia Messaging service, Instant Messaging service), contact addresses (SIP URI, Email, Instant Messaging address) and the priority of each of the communication means. The two principal functionalities of the Presence Service capability for a user are the subscription to the status of presentities and the notification of the changes in the status of these presentities.
In the subscription phase the Presence Service receives the Presence information of entities and enables the entities to subscribe to multiple presentities related to other entities. After authentication and authorization, the presence tuples associated to presentities for each entity as well as the group list of entities interested for different presentities, will be saved in the Presence server.
In the notification phase, the Presence information related to the entity will be generated and published as a notification to the subscribed entity.

2.1.2. Messaging Service Capability

Messaging Service capability [4] is responsible for transferring multimedia messages between entities. This transmission integrates different media types and formats used in different message types such as fax, SMS, Instant Messaging voicemail or e-mail as well as different communication ways including real-time, near real-time and asynchrony communication. The messaging service capability will be applied with following two principal functionalities: message handling and message transferring.

Message handling functionality refers to authenticating and authorizing the entity to establish a connection to the Messaging Service by verifying the profile of the entity through accessing directly to HSS or by retrieving the user messaging profile from S-CSCF.

In the message transferring phase, once the reception of the message is validated by the messaging service, it will route the message and deliver it to the receiver(s). Messages will be stored in the Messaging Server until delivered to the receiver's entity. Storing messages will recover eventual failures in transmission and will allow the server to resume message delivery in case of failure.

2.1.3 Conference Service Capability

The conference service [6] provides the means for a user to create, manage, terminate, join and leave conferences that are applied to different kind of media streams by which users may want to communicate such as audio and video media streams as well as instant message based conferences or online gaming. Conference Service provides also the ability to give information about these conferences to the involved parties.

Conference Service capability creates the conference after verifying the media parameters in the received SDP (Session Description Protocol) [9] and associates an appropriate Conference Server URI to the conference creation request according to the available media capabilities and policies. Other functionalities of the Conference Service capability allow users to invite or refer other users to a conference, to join to a conference and to leave the conference and to remove the participants from the conference.

2.2. Examples of Integrated Services

In this part we explain how the mentioned service capability examples are applied in the implementation of different multimedia services. We present two services that integrate the presence and the messaging service capabilities in order to provide the multimedia gaming and the multimedia messaging services.

2.2.1 Multimedia Gaming Service

A new integrated service could be proposed by integrating the existing service capabilities. For example, a service that provides conferencing during an online game according to the presence of the player could be implemented in the IMS service architecture by integrating the following service capabilities:

1) Presence Service capability for managing the entry and the exit of the players to and from the game and for notifying the players about the state of other participants of the conference.

2) Messaging Service capability for handling the multimedia messages exchanged in the multi-user and multi-domain platform of the conferencing service in IMS.

3) Conference Service capability for creating the conference at the SDP and RTP flows levels.

2.2.2 Multimedia Messaging Service (MMS)

MMS [7] can be implemented as a voicemail or a messenger. MMS verifies the presence of the called party to transfer directly the message to it. If the called party is not present, message will be saved in the messaging server until the called party becomes present and then the message will be forwarded to it. The service capabilities used in this service are:

1) Presence Service capability for managing the presence and the availability of the users

2) Messaging Service capability for saving the multimedia messages in the messaging server and for exchanging the multimedia messages between the caller and the called parties.

Invoking multiple service capabilities for implementing an integrated service and controlling the interactions that may occur between the service capability invocations are the challenges that concern the implementation of SCIM in IMS and are presented in the next part.

3 Service Capability Interaction Manager (SCIM)

In the IMS architecture, SCIM represents a middleware of building blocks between the control layer and the service layer that manages the interactions between services. Today there is no definition of the functionalities of the SCIM in the specifications and the standards and the development and deployment aspects of SCIM are still not clear.

In this part we distinguish two aspects of the SCIM implementation issues in order to provide mechanisms for invoking the service capabilities engaged in the implementation of the application server: 1) the procedural aspects, i.e. the functionalities and the approaches used to prevent the interactions between service capabilities; 2) the architectural aspects i.e. the mechanisms to design the service architecture in order to perform the functionalities of SCIM in the service platform of IMS.

3.1 Procedural aspects of SCIM

In the SCIM model that we present in this paper, SCIM prevents the interactions between services based on the user profile and the service operator policies, through the interfaces, illustrated in the following figure, between SCIM, S-CSCF and Services (Service Capability (SC) and Application Server (AS)). Therefore we divide the functionalities of SCIM in three parts:

I. Retrieving the user profile (SCIM/S-CSCF)
II. Invoking the services (SCIM/SC, AS)
III. Interacting with other SCIM (SCIM/SCIM)

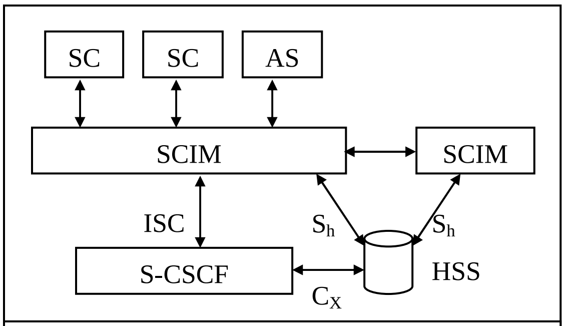

Figure 2: SCIM interfaces with network entities

I. Interface between SCIM and S-CSCF:

When a user registers to S-CSCF, the S-CSCF retrieves from HSS the relevant initial Filter Criteria (iFC) applied to the user. Afterwards these Filter Criteria that contains the address of the service to trigger in the SIP-URI format (e.g. myintegratedservice@as.operator.com) are applied in sequence according to their defined priority [2].
SCIM as the intermediate between the service execution logic placed in AS and SCs and the session control functions placed in S-CSCF will have to be aware of the SCs engaged in triggered services. This could be achieved by storing in the SCIM a formal model of all the services it may trigger. This formal model would explicit the decomposition of a service into service capabilities and the interactions needed between service capabilities and the end-users. As the service implementation in the application server involves multiple service capabilities, the service execution will be performed according to the mechanism by which the application servers and the service capabilities are invoked from SCIM.

II. Interface between SCIM and services:

SCIM may trigger multiple service capabilities for executing a single integrated service. Also one or more service capabilities may be shared between integrated services. For example the request of a subscriber of Multimedia Gaming service will trigger a Presence service capability and the MMS request of the same subscriber or another one may be triggered to the same Presence service capability.
Hence, the service platform will reuse the existing service capabilities to implement new services and there is no need to define new service building blocks for new services. Therefore a service capability interaction rule must be defined to express the order in which the service capabilities must be invoked in order to implement the application server. According to the defined service capability invocation rules the service capabilities will be successively invoked and in case of conflict between service capability interactions, based on the operator policy, the conflict resolution rules will be applied to prevent the interactions between service capabilities and the correct implementation of the application server will be assured.

III. Interface between SCIM and SCIM:

Interaction between SCIMs provides cooperation between different SCIMs of a domain, different domains and different service providers. Among service capability interaction management rules, SCIM can define some rules allowing S-CSCFs to exchange session control layer and service execution layer information. Also eventual accordance between service operators can be expressed in SCIM to allow SCIM to trigger service capabilities or application servers of other domains.

3.2 Architectural aspects of SCIM

In this part we compare to approaches for designing SCIM in the IMS architecture, between the service layer and the control layer:

1) Centralized approach: designing SCIM as an intermediate Application Server between S-CSCF and SCs.
2) Distributed approach: integrating and delegating the functionalities of SCIM to the S-CSCFs.

Figures 3 and 4 illustrate the implementation of multimedia gaming service and multimedia messaging service in the both of mentioned approaches. In these figures, multimedia messaging service contains the Presence (PS) and Messaging service (MS) capabilities and the multimedia gaming service is implemented by integrating Messaging, Conferencing (CS) and Presence service capabilities.

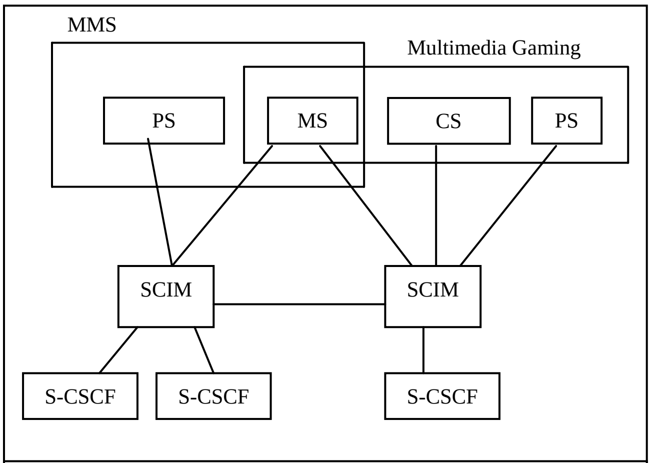

Figure 3: SCIM implemented over an intermediate AS

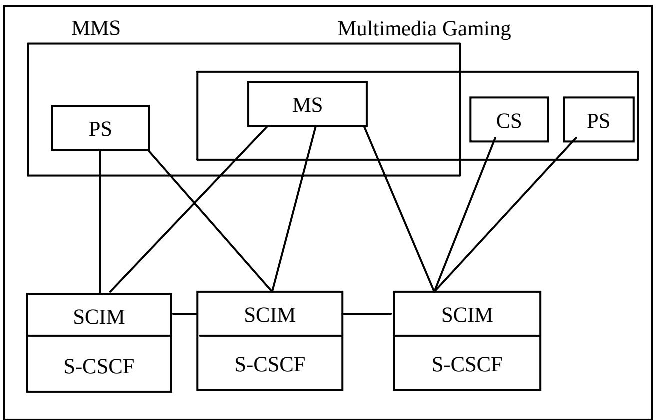

Figure 4: SCIM implemented over each S-CSCF

In figure 3, SCIM is a SIP application server that retrieves the user profile from S-CSCF and for each service for which the user had been subscribed; SCIM invokes the related service capabilities according to the defined service capability interaction rule. Therefore this approach is based on a central management entity that prevents the service capability interactions according to a) the stored user profile information related to the application servers to be invoked and b) the policy of the service capabilities that are integrated to implement an application server.

Due to the rapid evolutions in the service domain as well as the improvements in the functionalities of the core network entities, managing the service capability interactions in centralized points of the network will not be efficient because of the problems related to the scalability of the network, flexibility of new services and bottlenecks that may be created over the central manager points. Therefore in the second approach we replace these centralized SCIMs by distributed ones, i.e. by distributing the functionality of SCIM across S-CSCFs.

In figure 4, we follow the same generic service architectural framework suggested by [12] to distribute various functional entities engaged in the implementation of an integrated service. As it is illustrated in figure 4, the functionalities of SCIM are integrated as the APIs (Application Programming Interfaces) over S-CSCF. These APIs control the access of multimedia sessions to services as well as the previous approach by using defined service capability interaction rules. But in contrast with the first approach, in this approach each S-CSCF is involved in managing the interactions between the service capabilities and therefore instead of implementing the SCIM as the centre of the interaction management decisions, the interaction management tasks are delegated to S-CSCFs.

In addition, coordination and cooperation between S-CSCFs that contain the functionalities of SCIM provide a scalable solution to service capability interaction management problem and enable service level interworking. As each S-CSCF had already retrieved the user profile of its subscribers during registration, the interface between SCIM and S-CSCF in this approach will be less complex than the one used in first approach. Other benefit of the second approach is related to the fact that distributing the management task alleviates the eventual bottlenecks that appear in the centralized approach. Finally, this approach is more robust and fault tolerant than the first one, while failures in each of the S-CSCFs have less impact on the network than failure of a SCIM that manages the interactions related to multiple S-CSCFs.

4 Conclusion

In this paper we have first presented how new services introduced in 3GPP will be implemented by integrating and reusing the already existing service capabilities. Afterwards we have defined new possible approaches to implement SCIM in the service architecture of IMS. We have divided the SCIM implementation issues in two parts: the procedural and the architectural aspects.

From the procedural point of view, for each integrated service that it might trigger, SCIM must contain a predefined service capability interaction model that presents which service capabilities will be used in the implementation of the integrated services and in what order. Updating the SCIM and the service capability invocation list related to each service after the introduction of each new service will prevent the need for introducing new service building blocks when reusing the existing service capabilities is possible. In addition, the users will be ensured that service capabilities will be invoked correctly and the interaction between the service capabilities will be managed by SCIM.

From the architectural point of view, we compared two conceivable SCIM implementation architectures in IMS. In the first approach, SCIM can be implemented as a SIP application server and invokes the service capabilities related to an application server according to the predefined service capability interaction rules. This approach presents a centralize interaction management schema that provokes the problem of bottleneck at service capability interaction management level, as well as the lack of scalability and flexibility in the service architecture platform. In the second approach we integrate SCIM over S-CSCFs, therefore each S-CSCF is involved in managing the interactions between service capabilities and the limitations due to the bottleneck of the centralized manager are eliminated.

5 Future Works

I) Dynamic Extension of the service capability interaction rules:

The increased diversity in the domain of next generation services, demands extending the service capability interaction rules in order to cover the specifications of the innovative NGN services and to assure operators that by managing the interactions between standardized service capabilities new services will be implemented without requiring to introduce new standardized service building blocks. For example, Push to talk over Cellular (PoC) service as defined by OMA (Open Mobile Alliance) [10] is provided by IMS specifications of 3GPP [5] and this service can be implemented by integrating multiple service capabilities that manage the lists of the users engaged in PoC service. On the other hand, other service capabilities such as location and push services are integrated in the service capability based architecture of NGN to implement multiple integrated services [14]. Therefore the extension of the service capability interaction rules must be performed in a dynamic way to facilitate the introduction of new services.

II) Categorizing the services and the users:

Including and applying the service priority and the user priority to the interaction management criteria and considering simultaneously both of the user profile and the operator policy, as the essential interaction management criteria enable the service platform to provide a multi criteria service capability interaction manager to satisfy both the operator and the subscriber.

III) Extending the functionalities of SCIM to other service platforms than IMS:

SCIM proposed by 3GPP manages only the interactions between SIP based service capabilities. On the other hand, the IMS service architecture besides the SIP AS, provides access to the services of the third party service providers (i.e. Open Service Access Service Capability Server). Alternatively, service platform that do not imply the use of SIP protocol (i.e. Address Book or Group Management) will be used as service capability by integrated services. Modifications may be performed on the functionalities of SCIM to provide interfaces to these standardized service platforms in order to manage service interactions between all different service platforms of IMS.

References

[1] 3GPP, “IP Multimedia Subsystem (IMS)”, TS 23.228, Release 6

[2] 3GPP, “IP Multimedia session handling; IM call model”, TS 23.218, Release 6

[3] 3GPP, “Presence service using the IP Multimedia (IM) Core Network (CN) subsystem”; TS 24.141

[4] 3GPP, “Messaging using the IP Multimedia (IM) Core Network (CN) subsystem; TS 24.247

[5] 3GPP, “3GPP enablers for Open Mobile Alliance (OMA) Push-to-talk over Cellular (PoC) services”; TR 23.979, Stage 2

[6] 3GPP, “Conferencing using the IP Multimedia (IM) Core Network (CN) subsystem”, TS 24.147

[7] 3GPP, “Multimedia Messaging Service (MMS); Functional description”, TS 23.140

[8] IETF RFC 3261, “SIP: Session Initiation Protocol”

[9] IETF RFC 2327, “Session Description Protocol”

[10]http://www.openmobilealliance.org/tech/wg_committees/poc.html

[11] ETSI DTR-01024: “TISPAN; NGN; NGN generic capabilities and their use to develop services”, 2005-05.

[12] E.Bertin, E.Bury, P.Lesieur ; “Intelligent distribution in next-generation networks, an architectural framework for multimedia services”, IEEE International Conference on Communications, 2004.

[13] P.M. Carpenter, M.L.F. Grech; "Standardised service capabilities: the need for standardisation illustrated by the development of the presence service", 3rd International Conference on 3G Mobile Communication Technologies, 2002.

[14] Zarri, M., "Future service capabilities offered by the 3GPP system", 4th International Conference on 3G Mobile Communication Technologies, 2003.

[15] Arbanowski, S. et al., "I-centric communications: personalization, ambient awareness, and adaptability for future mobile services", IEEE Communications Magazine, 42(9):63-69, Sept. 2004