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Integration of Services Implemented on Different Service Platforms

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Abstract: *The paper studies the problem with service interaction. In mobile networks, classical value-added services are provided usually on intelligent network platform, namely Customized Application for Mobile services Enhanced Logic (CAMEL) platform. Advanced multimedia services are enabled by using Session Initiated Protocol (SIP) on the top of IP-based infrastructure. Simple integration of services implemented on different service platforms is not possible and requires special network functionality called Service Capability Interaction Manager (SCIM). SCIM provides means of wrapping services in legacy networks so that they can be orchestrated alongside new services. SCIM functionality is not specified in standards and 'live' SCIM implementations need to consider operators' service specifics. The paper focus is on integration of three services separately deployed in a mobile network, namely Prepaid service, Mobile Virtual Private Network (MVPN) service, and Voice over IP service. The specific for the mobile operator service configuration requires special control protocol mapping between SIP and CAMEL Application Part (CAP) which reflects the SCIM behavior. The aim is to define the required SCIM functionality for combination of those existing services. Different service interaction scenarios are investigated to identify the required SCIM behavior as a mediator between services. While the common SCIM behavior in translation between SIP and CAP is similar for a wide range of services, the differences are in the treatment of special use cases and protocol parameters. Based on the studied SCIM behavior, the requirements to SCIM are synthesized in a way that conforms to the implementation of Prepaid MVPN service deployed both in mobile and SIP based networks.*

Keywords: *Service interaction management, IP-based multimedia services, CAMEL services, prepaid, mobile VPN,Voice over IP.*

I. Introduction

The present day value-added services and applications are the moneymakers, providing potential for revenue generation. In the struggle to secure a piece of service market, network operators and service providers strive to offer attractive customer-oriented applications. Customized applications are operator specific services that are unique and differentiated from other applications offered by the competitors. An architecture for delivering value-added services in mobile networks provides Customized Application for Mobile Enhanced Logic (CAMEL) [1]. In CAMEL, call control functions related to call set up, monitoring and release are separated from service control functions i.e. service logic. This separation provides flexibility in service creation and service deployment. Initially CAMEL has been defined for circuit-switched services and later has been enhanced to support packet-switched services also. The latest solution for provisioning of all kinds of multimedia services uses Internet Protocol (IP) infrastructure and Session Initiation Protocol (SIP).

In transition to all IP based multimedia networks, operators are forced to integrate services provided on different service platforms. Simple integration of CAMEL services already deployed in the network is not possible since CAMEL allows just one service logic to control single call segment at a time. Service interaction becomes complicated when services are implemented on different service platforms. To combine existing services and to allow introduction of new ones, a functional component named Service Capability Interaction Manager (SCIM), is used [2]. High level definition of SCIM is given in [3] in the context of special type of application server which mediates between SIP-based services. Unfortunately, there is confusion over the different industry definitions, functionalities and benefits of SCIM that makes hard to differentiate between marketing and reality.

The problem with service interaction has been explored since the introduction of the Intelligent Network concept which provides means for easy and rapid creation of new services. The more services operate in the network, the greater chance is that they will somehow interfere with each other. This is called feature interaction problem. Feature interactions have been intensively studied by academia and industry in three directions: avoidance, detection and resolution [4, 5]. The usage of policies for defining features and for treating the feature interaction problem is suggested in [6, 7]. While features are low level and implementation specific and tend to be inflexible, policies are higher level, goal-oriented and very flexible [8]. Distributed feature composition presented in [8] is designed in response to feature interaction problem and is aimed to provide analysis and management of feature interaction. Irrespectively of the research in the area the problem is still an open issue in general and there is no global solution.

The variety of SCIMs available on the market is mainly supporting common for all CAMEL and SIP based services interactions, which include control protocol translation. However, there is a subset of specific CAMEL service implementations in the operators' domains that imposes requirements, fulfilled partly by SCIM. This

is where all solutions to service interaction problem appear to break down. This is not because the quality of the research has been substandard, but because the service interaction problem is more complex. The specific for the mobile operator service configuration requires special mapping between SIP and CAMEL Application Part (CAP) protocol which reflects the SCIM behavior.

The paper's focus is set on interaction between two CAMEL-based services with specific implementation and a SIP-based service already deployed in a "live" mobile network. The CAMEL-based services are Prepaid and Mobile Virtual Private Network (MVPN), and the SIP-based service is Voice over IP (VoIP). The three services are implemented on different service platforms. Combination of Prepaid and MVPN services requires functionality of SCIM to handle CAP dialogs between call control and control of the service logics. The mediating function of SCIM is also needed to involve the VoIP service logic control and in addition to CAP, SCIM has to "talk" SIP. While the common SCIM behavior in translation between SIP and CAP is similar for a wide range of services, the differences are in treatment of special use cases and protocol parameters.

The aim of the research is to define the required SCIM functionality for combination of those live services without violating service behavior for existing service subscribers. SCIM has to resolve interactions which are result from how the services are implemented, because the same service, from the user's perspective, may be implemented in different ways, causing different types of interaction with other services. Along with the common for all CAMEL and SIP based services behavior of SCIM, specific use cases have to be investigated to reflect the operator specific service implementation.

The paper is structured as follows. First we present required network configuration and service deployment with operator specific service features. Different call flow scenarios are examined to model the expected service interaction behavior. Next, typical call types are described in a billing context in order to specify details of handling calling and called party numbers. Finally, based on the studied SCIM behavior the requirements to SCIM are synthesized in a way that conforms to the implementation of Prepaid MVPN service deployed both in mobile and SIP based networks.

II. Service deployment

II.1. IP multimedia subsystem

IP-multimedia subsystem (IMS) is service control architecture aimed to provide all kinds of multimedia services based on common IP platform [9].

The central role in IMS is played by Call Session Control Functions (CSCFs) used for multimedia session control and address translation. In addition, the CSCFs manage service control, voice coder negotiation for audio communication, and authentication, authorization and accounting. There are three kinds of CSCFs: Serving CSCF (S-CSCF), Proxy CSCF (P-CSCF) and Interrogating CSCF (I-CSCF). The P-CSCF is the first point of contact for the user equipment (user

terminal) in the IMS. It is responsible for the security of SIP signalling between the user and the IMS, and SIP compression. The I-CSCF plays a role of a SIP signalling gateway to external networks. It is responsible for assignment of an S-CSCF to the user during registration and for routing the incoming requests to the assigned S-CSCF or application server. The S-CSCF is the "brain" of the IMS and it is always located at the home network. It performs session control and registration of user terminals. The control protocol for provisioning multimedia services is based on SIP. Session Description Protocol (SDP) is used with SIP for media description [10].

The media resource functions are used for providing specialized resource functions like playing announcements and tones. Media Resource Function Controller (MRFC) controls media resources.

In IMS, the Application Server (AS) delivers value-added services. If the S-CSCF determines that the AS must be involved, it delegates the session control to that AS. The interface between the S-CSCF and the AS is based on SIP. There are several types of application servers:

- SIP AS hosts applications that are able to influence the session control by receiving and emitting SIP signalling.
- The IP Multimedia Service Switching Function (IM-SSF) is an AS that allows services based on CAMEL service logic to be involved in session control.
- The Open Service Access Service Capability Server (OSA SCS) provides open interfaces for third party applications.
- In addition, there is a specialized type of SIP Application Server, the SCIM which performs the role of interaction manager between other application servers.

Home Subscriber Server (HSS) is an authentication server that stores authentication parameters applied for the users and user profiles that contain information about the media types that the users are authorized to use, and about the services that are to be applied to the users.

The IM-SSF interfaces between the IMS domain and the CAMEL service environment [11]. It converts between IMS Service Control (ISC) and CAMEL service control. ISC is the protocol that is used between the S-CSCF and a SIP AS. The IM-SSF acts as SIP AS towards the IMS core network. At the same time, the IM-SSF acts as service switching function towards the CAMEL service control. It maintains a consistent view on the call states by IMS Basic Call State Model (IM-BSCM). The IM-SSF invokes an instance of Originating IM-BCSM or a Terminating-IM-BCSM instance for an IMS call. The functional entity that facilitates the CAMEL service execution is called Service Control Function (gsmSCF). The protocol between IM-SSF and gsmSCF is CAP [12].

Fig. 1 shows the network architecture for provisioning integrated CAMEL and SIP-based services.

II.2. Services

Mobile Virtual Private Network (MVPN) is a service that enables a group of users (e.g. employed by given company) to specify a common numbering plan of short numbers, which can be identical to their office extension numbers [13]. Short

numbers are dialed for calls within the group, while calls to subscribers outside the MVPN group require regular number dialing. The service implementation allows subscriber profile definition. The subscriber profile imposes restrictions on placing calls. Preferential rates are defined for calls between MVPN subscribers in a group (on net calls). The MVPN service is provided with features such as short dialing, split billing, black/white originating screening, announcements, time-based separation and call forwarding.

The Prepaid service allows users to pay in advance and to use network services without having subscription. Information showing the available balance is stored in the network [14]. A network database is updated each time the card is used for calls or replenished, and the card number is only a reference to a field in the database. The Prepaid service is provided with features such as originating user prompter, call gapping, announcements with support of multiple languages.

In the following scenarios, we use the abbreviation SCFmvpn instead of the gsmSCF responsible for the MVPN service logic and the abbreviation SCFprepaid instead of the gsmSCF that provides control logic for Prepaid service.

The VoIP service provides voice communications over SIP-based infrastructure. For the sake of simplicity we assume that the VoIP service does not apply operator-specific call control to a call which means that the functionality of SIP AS is not needed.

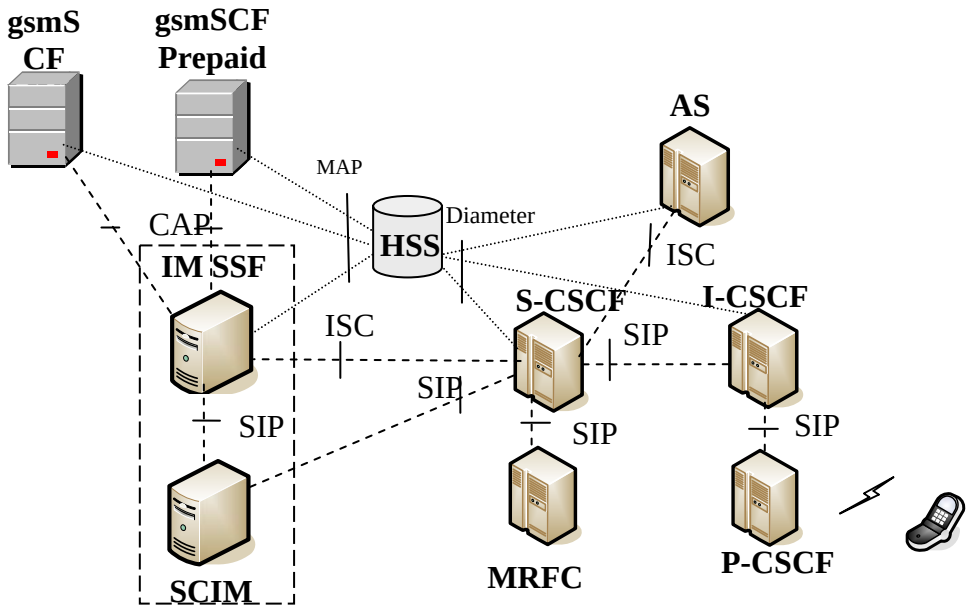

Fig. 1. Network architecture for interaction between Prepaid, MVPN and VoIP services

The combination of the MVPN, Prepaid and VoIP services allows a company subscribed to MVPN service to supply some of its employees with prepaid cards as part of the MVPN group. The charging for these subscribers is done on-line on the base of preferential rates defined for the company. The combination of these

CAMEL-based services with the VoIP service allows the Prepaid MVPN service to be offered to IP subscribers also. The integrated voice service is provided on an IMS platform.

When a subscriber registers as IMS user, the S-CSCF receives initial filter criteria (IFC) from the HSS. IFC consist of criteria that define when the S-CSCF will route an IMS session through a SIP-AS. IFC are subscriber-specific. On registration the IM-SSF receives from the HSS CAMEL Subscription Information (IM-CSI). In case of Prepaid MVPN and VoIP service interaction, the subscriber has Originating-IM-CSI which means that the IFC for that subscriber should contain settings that indicate that the S-CSCF shall route the SIP INVITE for an originating call, to the IM-SSF. When the IM-SSF receives the SIP INVITE from the S-CSCF, it invokes an instance of the O-IM-BCSM. As the SIP INVITE relates to an originating IMS call, an O-IM-BCSM instance is created. The parameters that are needed to invoke the CAMEL service, such as the address of the node that hosts gsmSCF, Service Key, etc. are obtained from the O-IM-CSI. The IM-SSF converts the SIP INVITE received from S-CSCF into a CAP Initial Detection Point (IDP). From this point onwards, the IM-SSF serves as a relay between S-CSCF and gsmSCF: SIP methods (and responses) from S-CSCF are converted to CAP operations to SCF and CAP operations from SCF are translated to SIP methods to S-CSCF.

CAMEL allows control of one service logic on a call segment. To allow control of both Prepaid and MVPN service logics the IM-SSF needs to play role of SCIM. In the following service interaction scenarios, we consider the combined IM-SSF and SCIM functionality.

III. SCIM behavior in case of service interaction

From a signaling point of view there are two call flow scenarios in case of Prepaid, MVPN and VoIP service interaction. The first scenario is applicable, if the Prepaid MVPN VoIP user that places a call has sufficient credit. The second scenario is applied if the subscriber's credit is insufficient.

A precondition for call initiation is that the calling user is registered. On successful registration the S-CSCF receives from the HSS the user profile including initial filter criteria for triggering the logic in the SCIM. The service trigger point in the user profile includes an INVITE request from the VoIP user which will trigger the MVPN and Prepaid service logics.

III.1. Mobile originating call with sufficient credit

A VoIP user with Prepaid MVPN subscription initiates a call allowed by subscriber's profile. The subscriber's prepaid account contains sufficient amount to make the desired call. Fig. 2 shows the call flow scenario. SIP message 100 Trying is sent after each INVITE request but it isn't shown. The call flow is as follows:

1. An IP user with Prepaid MVPN subscription places a call. The calling user equipment sends a SIP INVITE message to the P-CSCF. The Session-Expires header field is used to specify the expiration time of the session. The proposed session description is carried in this message. The 100 Trying response reassures

the user equipment that the INVITE is being processed (not shown). The P-CSCF includes the P-Charging-Vector header field in the INVITE message to send access network charging information. The INVITE is forwarded to the S-CSCF.

2. The S-CSCF performs service control based on IFC and call data. The S-CSCF determines that it must contact with the SCIM/IM-SSF. The INVITE message is forwarded towards the IM-SSF.

3. Upon receiving the INVITE message, the SCIM stores the session information. The Originating-IM-BCSM is started at the IM-SSF. The IM-SSF encounters the Collected_info detection point and determines the service logic to contact to (SCFmvpn). The IM-SSF/SCIM formulates the first Initial Detection Point (IDP) message and triggers the MVPN service logic.

4. The MVPN service logic ascertains that the subscriber is allowed to place the call by checking the subscriber's profile. For on net calls the SCFmvpn determines that the subscriber should be presented to the called party with his/her short number. The SCFmvpn sends a Connect message to SCIM. The Connect message contains Generic number with the calling party's short number only when "presentation with short number" feature is active. Otherwise Generic number parameter is missing. In case a Prepaid MVPN subscriber has been detected from the SCFmvpn as calling party number, then the called party number has to be prefixed (with a specific predefined prefix) in order to apply special charging (depending on the prefix).

5. The SCIM has O-IM-CSI related to the Prepaid service for the subscriber. SCIM determines with which SCF has to contact. SCIM triggers the Prepaid service in the SCFprepaid. The parameters of the second IDP are extracted from the stored session information. The exception is the Called party number which is received from the SCFmvpn within Connect message of the first CAP dialog.

6. The service logic for the Prepaid service checks the current credit of the subscriber's prepaid account and determines the amount of time for which the call is allowed.

7. The SCFprepaid instructs the SCIM to monitor for called party answer event and disconnect event and to report on the event occurrence by sending Request Report BCSM Event (RRB).

8. The SCFprepaid sends charging instructions to the SCIM by sending a Send Charging Information message.

9. The SCFprepaid instructs the SCIM to control charging and to report after the call completion by sending Apply Charging message.

10. The SCFprepaid instructs the SCIM to allow the call to proceed for a limited amount of time by sending Connect message.

11. The SCIM subscribes to receive notifications for called party answer and disconnect events.

12. The S-CSCF acknowledges the subscription.

13. The SCIM acting as SIP proxy sends the INVITE request to instruct the S-CSCF to route the call to the destination. The SCIM uses the charging instructions sent by SCFprepiad to formulate the P-Charging-Vector header of the INVITE message. The SCIM shortens the session expiration time by reducing the interval in the Session-Expires header field according to the instructions sent by the SCFprepaid.

14. The INVITE message is sent further to its destination. Bearer establishment and call setup between the calling and called parties is performed following basic call flow for originating, inter-network and terminating segments.

15. The setup is completed by the ACK sent to the called party via the signaling path. The media session is now established. During a session, the S-CSCF generates the call detailed record for charging purposes.

16. The S-CSCF notifies the SCIM/IM-SSF about the called party answer event occurrence.

17. The SCIM confirms the notification.

18. The SCIM/IM-SSF reports the event to the SCFprepaid.

19-20. The calling UE sends BYE to terminate the call. The message is forwarded via the S-CSCF to the called party. On receiving BYE message, the called party confirms the call release.

21-22. The SCIM/IM-SSF is informed about the call release. The request contains a P-Charging-Vector header used to produce charging records. The SCIM confirms the notification.

23. The IM-SSF reports the release event to the SCFprepaid.

24. The IM-SSF reports to the SCFprepaid the information requested in the Apply Charging Report message. SCFprepaid updates the credit.

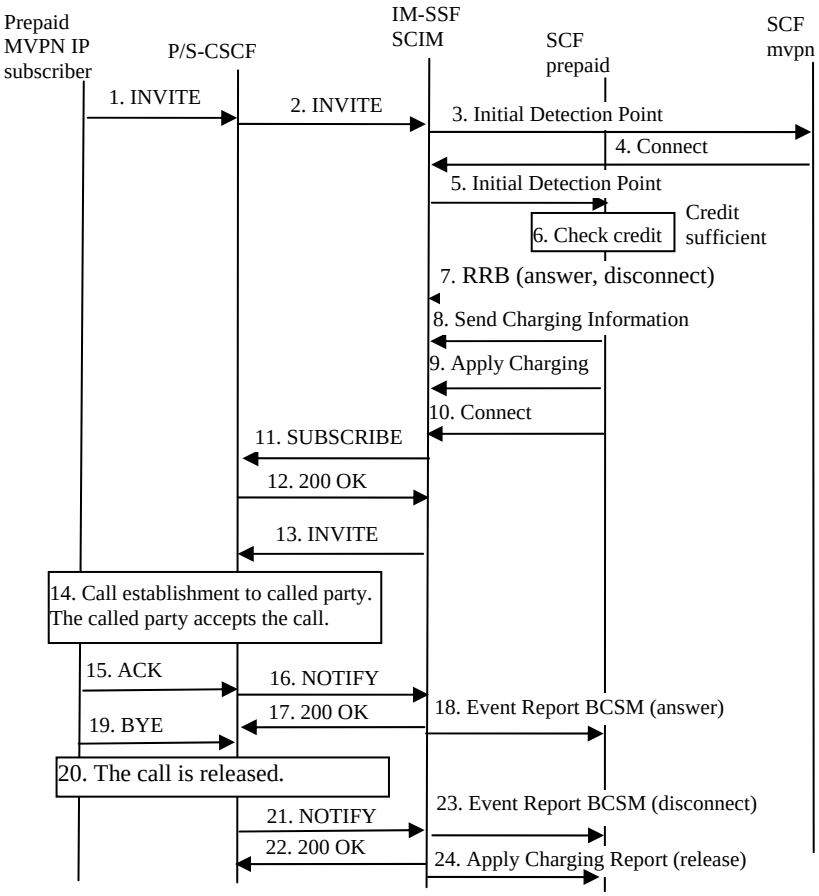

Fig. 2. Originating call from Prepaid MVPN IP subscriber with sufficient credit

III.2. Mobile originating call with insufficient credit

An IP user with Prepaid MVPN subscription places an originating call that is not restricted by the subscriber's profile. The subscriber's prepaid credit is insufficient to place the desired call. The call is not allowed and the subscriber is played an announcement. Fig. 3 shows the call flow for this scenario. The procedure is as follows:

Steps from 1 to 5 are the same as in Fig. 2. Upon receiving the first INVITE request from the calling subscriber the S-CSCF creates a dialogue for Call ID 1.

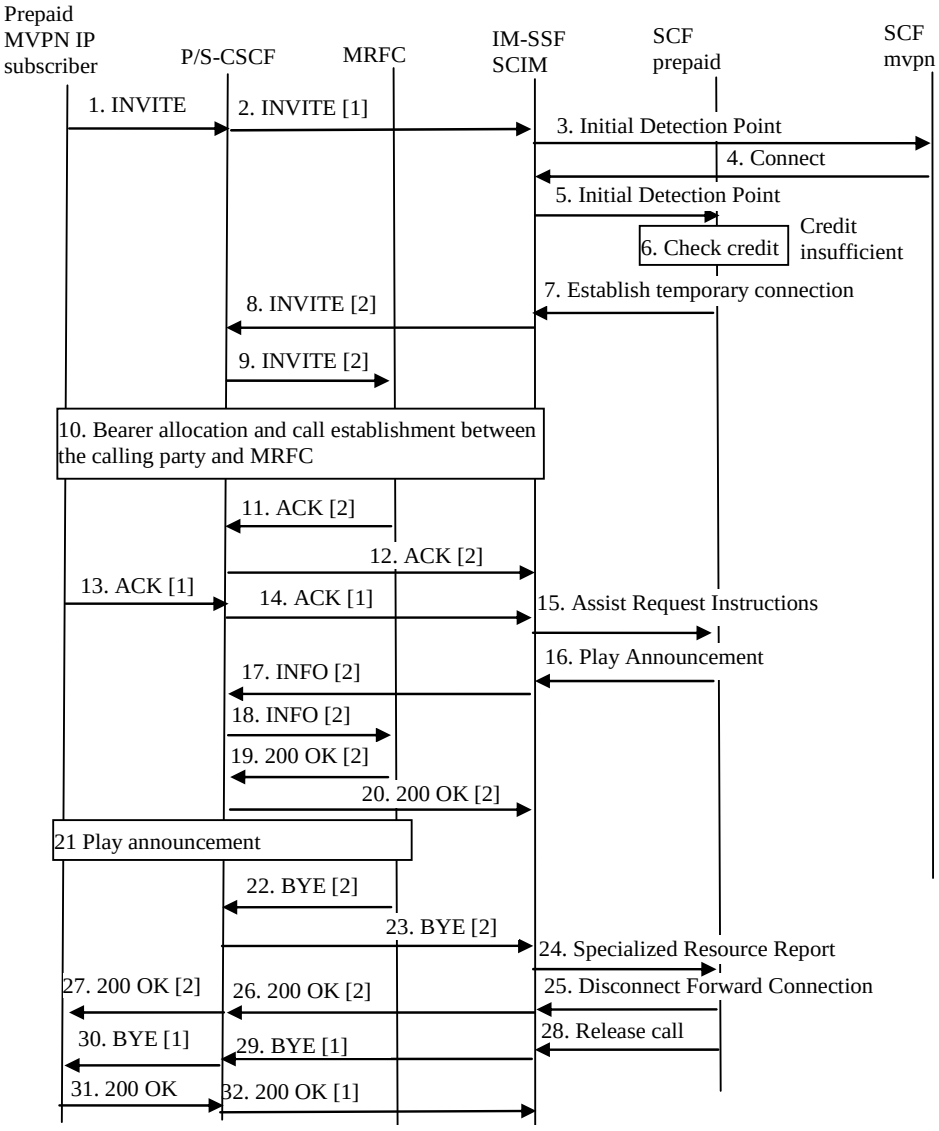

Fig. 3. Originating call from Prepaid MVPN subscriber with insufficient credit

6. The Prepaid service logic checks the current credit of the subscriber's prepaid account, determines that the credit is insufficient and the subscriber must be played an announcement.

7. The SCFprepaid sends instructions to create connection between the calling party and MRFC.

8. The SCIM/IM-SSF formulates a new INVITE request for establishment of dialog to play announcement. The INVITE message does not specify any details for the announcement. A new dialogue for Call ID 2 is created.

9. The new INVITE request is sent to the MRFC via the S-CSCF to establish a new dialog for playing the announcement.

10-14. The MRFC allocates the requested resource. The SCIM manages the dialog for Call ID 1 as normal with the session description supplied from MRFC.

15. On receiving acknowledgement for establishing connection to the announcement machine, the SCIM/IM-SSF request instructions from SCFprepaid.

16. The SCFprepaid sends instructions for playing announcement. The Request Announcement Complete Notification parameter indicates that Specialized Resource Report must be sent when the announcement has been played.

17-20. The SIP INFO request is used to send call signaling information concerning the message to be played within the established dialogue with the MRFC.

21. The announcement is played.

22-23. The MRFC indicates that the announcement is complete.

24. The SCIM/IM-SSF reports that the announcement has been played.

25-27. The SCFprepaid explicitly requests to disconnect the connection to the media resource established previously with Establish Temporary Connection message. The dialogue for Call ID 2 is terminated.

28. Instructions are sent to release the call.

29-32. The dialogue for Call ID 1 is terminated.

IV. Handling calling and called party numbers

For VoIP communications interaction between Prepaid and MVPN services occurs for originating calls allowed by subscriber's profiles. In billing context, the following call types might be recognized:

- On-net call – a Prepaid MVPN VoIP subscriber places a call to another MVPN VoIP subscriber in the same MVPN group by dialing his/her short number or public MSISDN.
- Virtual on-net call – a Prepaid MVPN VoIP subscriber places a call to another MVNP VoIP member by dialing his/her MSISDN number.
- Intra holding call – a Prepaid MVPN VoIP subscriber places a call to another MVPN VoIP subscriber in the same holding group by dialing defined MVPN account access code and his/her short number or public MSISDN number.
- A Prepaid MVPN VoIP subscriber places an off net call i.e. calls to a subscriber which is not a part of the respective MVPN group or respective Holding

group and is not defined as virtual on net user of the respective MVPN group by dialing his/her MSISDN number.

- A Prepaid MVPN VoIP subscriber places a Freephone call i.e. calls a Freephone number.
- A Prepaid MVPN VoIP subscriber places a Value-added Service call, i.e. calls a VAS number.
- A Prepaid MVPN VoIP subscriber places a call to a special number such as *77, *97000, 17000, emergency numbers.

For all call types, the scenarios considered in section III differ in the parameters of the CAP and SIP messages.

In the context of service interaction, it is reasonable to consider the message parameters because of the private numbering plan, the different charging tariffs applied by MVPN service and the on-line charging applied by Prepaid service. The most important parameters handled by SCIM, SCFmvpn and SCFprepaid are calling party and presentation numbers, dialed and called party numbers. The presentation number is provided by the Generic number parameter.

The MVPN service allows different preferential tariffs for on net and off net calls to be defined for particular companies. The Prepaid service need to be aware about the different tariffs when checking the current subscriber's credit. A possible way for supplying the Prepaid service logic with this information is to distinguish different tariffs by adding a tariff-specific prefix to the called party number. That called number manipulating has to be done by the MVPN service logic and the Prepaid service logic needs to have knowledge about tariffs related to particular tariff-specific prefixes.

A. On-net Call

A Prepaid MVPN subscriber places an on net call. The subscriber dials the short number or MSISDN number of another MVPN subscriber in the same MVPN group. The call is placed during a predefined working time. The calling subscriber is presented with his/her short number or MSISDN number (the choice is up to the respective company whether the presentation has to be by short number or by MSISDN). The called party number in the Connect message sent by SCFmvpn to SCIM and in the IDP message sent by SCIM to the SCFprepaid is the called party MSISDN with prefix. The prefix is based on the tariff that is specific for a particular company. After analyzing the prefix, the SCFprepaid determines the tariff and removes the prefix. The Connect message sent by the SCFprepaid contains the called party number without prefix.

B. Intra Holding Call

A Prepaid MVPN VoIP subscriber places an intra holding call. The subscriber dials the predefined VPN account access code and the short number or the MSISDN number of another MVPN subscriber in the same holding group. The calling subscriber is presented with his/her MSISDN number. The called party number in the Connect message sent by SCFmvpn to SCIM and in the IDP message sent by SCIM to the SCFprepaid is the called party MSISDN with prefix. The prefix is handled as described above.

C. Virtual On-net Call

A Prepaid MVPN subscriber places a virtual on net call. The subscriber dials the MSISDN number of a virtual on net member. The calling subscriber is presented with his/her public MSISDN number. The called party number in the Connect message sent by SCFmvpn to SCIM and in the IDP message sent by SCIM to the SCFprepaid is the called party MSISDN with prefix. The prefix is handled as described above.

D. Off Net Business Call

A Prepaid MVPN subscriber places an off net call. The subscriber dials the public MSISDN number of a subscriber which is not part of the respective VPN group or respective Holding group and is not defined as virtual on net user of the respective VPN group. The calling party is presented with the public MSISDN number. The called party number is presented with the MSISDN.

E. Off Net Private Call

A Prepaid MVPN subscriber places a private off net call. The subscriber dials specific prefix before the MSISDN number of the called party. The call should be charged on his/her private bill. The calling party and the called party are presented with their public MSISDN numbers.

For the Prepaid service there is no difference between private and business calls as the same tariff is applied. The difference between private and business calls is made by the MVPN service in order to exclude private calls from business billing.

F. Special numbers

A Prepaid MVPN subscriber dials a Freephone number or Value-Added Service (VAS) number. The Prepaid service logic is aware of the Freephone and VAS numbers defined. In the context of service interaction the call is treated as off net call.

A Prepaid MVPN subscriber places a call to a special number such as call center or emergency numbers. The call must be free of charge. SCIM must not activate the Prepaid service.

G. Converting SIP addresses into telephone numbers and vice versa

While in circuit-switched networks like Public Switched Telephony Network (PSTN) or Global System for Mobile Communications (GSM) the subscribers are addressed by their telephone numbers, in IMS, users are usually identified using a SIP URI (Universal Resource Identifier). In general, SIP URIs identify communication resources. They contain enough information to initiate and maintain a communication session with the resource. A SIP URI uses the “sip”: scheme and has the form *sip: userinfo@hostport [parameters] [headers]*.

The hostport part identifies the source providing the resource. It may contain a Fully Qualified Domain Name (FQDN) or an IP address plus an optional port value. Additionally, the SIP URI may contain a number of parameters that affect the

request constructed from the URI. URI parameters are added after the host-port part, and are separated by semicolons.

The tel URI allows a VoIP user to be able to place a call to a user in PSTN or GSM. The tel URI consists of a telephone number, and identifies a resource in the telephone network [15]. Another use of tel URIs is for allowing calls from GSM/PSTN to VoIP users. GSM/PSTN phones do not allow the user to introduce a sip URI in order to place a call to an VoIP user. In order to enable this scenario, VoIP users need to be given an identity in the form of a tel URI so that they can be reached from the GSM/PSTN. A tel URI complies with the following format: *tel: telephone-subscriber*, where telephone-subscriber may indicate a global number or a local number. Local numbers belong to private numbering plans, and have meaning only within a certain context. They may, for instance, represent extensions within a MVPN, for example the tel URI representing a local number must include the phone-context element *tel:4444; phone-context_mvpn1.mtel.bg.*

Telephone numbers (MSISDN) are allocated to VoIP users to allow them to receive calls from circuit-switched networks. In other words, these users need to have a tel URI identity (possibly in addition to the SIP URI identity). The Media Gateway would receive a telephone address, would convert it into a tel URI, and would resolve the tel URI into SIP URI by using an ENUM query. The ENUM (E.164 to URI Dynamic Delegation Discovery System) defines a mechanism for using the Domain Name System (DNS) for storage of E.164 numbers. The mechanism allows resolving telephone numbers into SIP addresses. This scenario is depicted in Fig. 4.

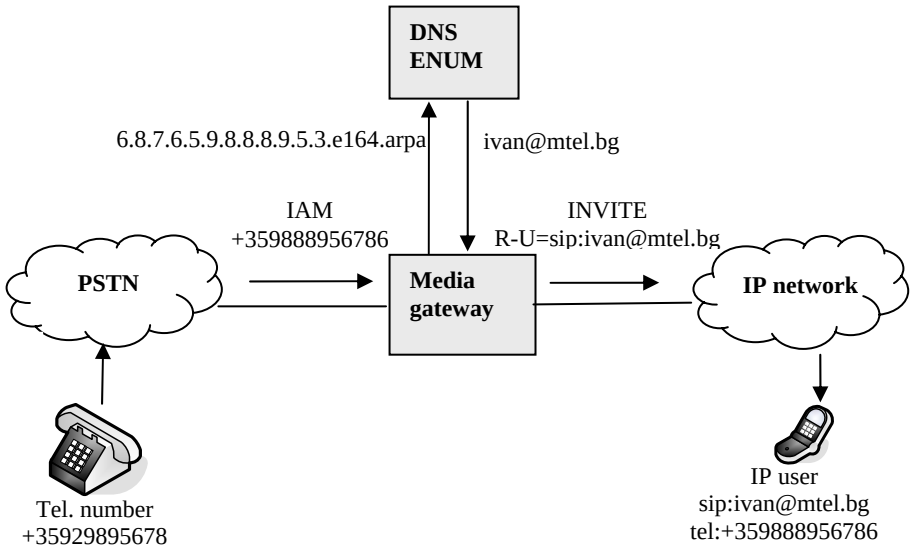

Fig. 4. Resolving telephone numbers into SIP addresses

V. Summary of the requirements to SCIM

This section summarizes the requirements to SCIM. The requirements to SCIM include the following:

- Common requirements;
- Configuration of CAMEL subscription information;
- Service logic activation;
- Call handing;
- User interaction handling;
- Special number handling;
- Service specific CAP message parameters.

A. Common requirements

When SCIM is used to combine already deployed CAMEL based services in IMS environment, it is reasonable to implement IM-SSF as an integral part of SCIM. The SCIM/IM-SSF must communicate with the gsmSCF, hosting the Prepaid service logic, and with the gsmSCF, hosting the MVPN service logic, via CAP 2 protocol. The main characteristics of CAP 2 include an extended call model, in-band user interactions, charging features and interaction with GSM supplementary services.

The SCIM must “talk” SIP for communications with the IM-SSF and the S-CSCF.

In order to support the full CAP functionality the SCIM/IM-SSF needs to support some optional header fields of the SIP messages. The Session-Expires header field is used to specify the expiration time of the session. This header field may limit the granted call duration as to instructions sent by the gsmSCF. The SCIM/IM-SSF must use the charging instructions sent by SCFprepaid to formulate the P-Charging-Vector header. The Expires header field is used to report that the called party does not answer.

B. Configuration of CAMEL subscription information and service logic activation

As it was mentioned in section II, service triggering information is presented in the form of initial filter criteria. IFC describe when the incoming SIP message is further routed to a specific AS. To provide the Prepaid MVPN service for IMS subscribers, it is necessary to contact with two application servers. The S-CSCF contacts with the AS providing VoIP service for the translation between the subscriber telephone number (MSISDN) and his/her SIP URI. The S-CSCF also contacts with the SCIM as special type of AS.

The service point trigger in the IFC comprises the request URI of the subscriber, originating and terminating session case, and the SIP method INVITE. No special SIP headers values for To and From headers are required due to capabilities to make both calls towards MVPN subscribers and off net calls.

The leading service must be the MVPN as the Prepaid service needs information about the call destination. The MVPN service logic is activated for both originating and terminating calls and therefore the IM-CSI in the SCIM needs be

configured with O-IM-CSI and T-IM-CSI containing the MVPN service code. For no roaming scenarios SCIM needs to store just the O-IM-CSI with Prepaid service code.

C. Call handling

The details on the required SCIM behavior are extracted from service interaction scenarios which are presented in the previous sections.

SCIM/IM-SSF uses the call information in the INVITE message received from the S-CSCF to formulate the first IDP to the SCFmvpn.

SCIM must have some logic to trigger the second service, if the first activated service has sent instructions to connect the call. SCIM should not trigger the second service, if the first activated service has sent instructions to release the call.

In formulating the second IDP message, SCIM must use call information in the INVITE message received from the S-CSCF. The called party number is derived from the Connect message sent by the SCFmvpn. If the Generic number parameter is returned in the first Connect message, this parameter is included as mandatory parameter. In formulating the second IDP message, SCIM uses the service code of the Prepaid service that is to be triggered.

SCIM must send an INVITE message to the S-CSCF based on the second Connect message, received from the Prepaid service logic.

SCIM must send a BYE message to S-CSCF, if any service sends Release call message.

In case of terminating calls to a Prepaid MVPN VoIP subscriber, who is in his/her home network, SCIM must not activate the Prepaid service logic.

D. User interaction handling

Two alternatives for the implementation of the dialogues between the IM-SSF/SCIM, S-CSCF and MRFC are possible. In the first one, the gsmSCF requests the IM-SSF to establish connection to specialized resource for playing announcement. On receiving acknowledgement for connection setup, the IM-SSF sends Assist Request Instructions message asking for further instructions. The INFO method is used for sending gsmSCF (SCFprepaid) instructions for playing announcement. When a Specialized Resource Report was requested in a Play Announcement message or in a Prompt and Collect User Information message the INFO is also used. This alternative is shown in Fig. 3.

In the second alternative, the gsmSCF sends instructions for user interaction to IM-SSF/SCIM which in turn establishes new dialog with the MRFC by formulating an INVITE message. Sufficient information is included to specify the details for the announcement. The BYE method is used to send Specialized Resource Report message.

E. Special number handling

SCIM must have some logic for special call handling in case of dialing of predefined numbers. Emergency calls are to be served irrespectively of the subscriber location or the subscriber’s account. The subscriber must be able to recharge his voucher irrespectively his location. Calls to the Call center require

special handling too. This means that after resolving the special number dialed, the SCIM activates neither Prepaid nor MVPN service logic.

F. Service specific CAP message parameters

The private numbering plan specific for the MVPN service requires special handling of calling and called party numbers. Details on handling calling and called party numbers by SCIM are provided in Section IV.

One of the most important issues is the provisioning of the Prepaid service logic with knowledge about different preferential tariffs defined for MVPN service which can vary for particular companies. A possible solution is adding a tariff-specific prefix to the called party number.

VI. Conclusion

For operators who want to add value to existing services by combining them, SCIM provides means of wrapping legacy systems and services so that they can be orchestrated alongside new services. In combination with IM-SSF, SCIM is responsible to trigger different service logic instances. SCIM allows several service logic instances to control the same call segment at a time. This means that SCIM must possess means to arbitrate between service logic instances that try to execute incompatible requests. What makes the question of service interaction really complex is the great number of customized services and service dialects and all the possible combinations of calling and called parties that can occur on different networks. In managing interaction between services implemented on different service platforms, SCIM must consider the specifics of service implementation.

In this paper we identify the specific SCIM behavior needed to orchestrate services already deployed in a “live” network. Along with the common functions concerning translation of SIP signaling into CAP signaling and vice versa, SCIM needs to support functions which are specific for service implementation and usually are not considered in the solutions on the market. The paper investigates the interaction between particular services, but it identifies the issues that have to be studied in any operator or service provider specific service interaction. Special issues are configuration of CAMEL subscription information, service logic activation, SCIM behavior in call and user interaction handing, and special number handling. As far as service features like private numbering plan, abbreviated dialing, one number, personal number etc. are configured, it is reasonable to investigate the calling party number, presentation number, dialed number, and called party number as transferred between different service logics. Charging service features like prepaid, premium rate, reverse or split charging also have to be considered in managing service interactions. An approach to identification of requirements to SCIM that conform to live services is to study all possible interaction scenarios covering both typical and specific behavior.

As far as SCIM appears to be key functionality in service orchestration, the available SCIM solutions can provide common for all services basic functions, but in order to be used in a real network the SCIM needs to be adapted to specific service implementation.

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