Technical Specification Group Services and System Aspects *TSGS#10(00)0598*
Meeting #10, Bangkok, Thailand, 11-14 December 2000

Source: TSG SA WG2

Title: 23.228 v.1.4.0 and Stage 2 Items still to be Addressed on 23.228

Agenda Item: 7.2.3

Introduction

We have made great strides and are nearing the time for completion of the Stage 2 work on the IM Subsystem in S2. It seemed an appropriate time to begin to compile a list of the items that still need to be addressed such that these items can be prioritized and can help to guide subsequent contribution and discussion.

Discussion

Thus far we have addressed many topics in support of the development of stage 2 information to guide the work of other TSGs in their development of the IM Subsystem. However there are still a number of areas that need to be explored in order to complete this work. The following list of work items is a first cut at compiling such a list. This list is currently in no particular priority order.

Stage 2 Items for Completion	**Associated document**	**Priority**
Call flows showing the allocation of MRF and MGW resources for transcoding, bridging, announcements, etc. to clarify these functional entities, their actions, and the actions of their controllers.	24.228, 24.229	
Call Release Call Flow Scenarios	24.228, 24.229	
Multi-point call flow scenarios	24.228, 24.229	
Multi-media call flow scenarios	24.228, 24.229	
Call flows for unregistered mobile	24.228, 24.229	
Call flows with CS endpoints where different from PSTN (e.g., IM User in CS domain)	24.228, 24.229	
Call flows with Internet SIP endpoints	24.228, 24.229	
Basic services call flows e.g., call forwarding, call waiting, call transfer, etc.	24.228, 24.229	
Information Flows showing mobility while registered	24.228, 24.229	
Information flows showing roaming in CS Domain	23.221	
Information flows for emergency services	24.228, 24.229	
Information flows for local services	24.228, 24.229	
Information flows for the selection of the domain where to route an incoming call.	23.221	
Information flows for session Authentication/Authorisation (*)	33.102	
Information flows for Accounting / charging data (*)	???	

Routing and addressing (public / private user Id). Number and name portability issues	24.228, 24.229, 23.003	
Requirements for Cx interface protocol(s) (*)	???	
Requirements on the interface between P-CSCF and GGSN	23.221, 23.002	
Limit the choice of the QoS scenarios to reserve the bearer level resources	23.207	
Limit the choice of the protocol on interface between CSCF and service platform.		
Impacts of radio resource saving tools (header stripping / compression, UEP, …) on the architecture.	23.221, 23.060	
Consequences of radio degration (e.g. lack of radio resource after a HO) on a SIP session.	23.060 (?), 25.413 (?)	
Categorizing the service capability features of the elements of IM sub-system	23.002 (?)	

(*) For these items S2 has only a second ~~responsbility~~ responsibility

Proposal

The list from the above section should be discussed and revised based on input from the S2 group at large. A final list of work items should be agreed upon and a priority order established. This should then be used to organize the agendas of subsequent meetings so that we are addressing the highest priority items first. This would then help to direct contribution activity in the best areas.

3G TS 23.228 V1.4.0 (2000-11)

Technical Specification

3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; IP Multimedia (IM) Subsystem - Stage 2 (3G TS 23.228 version 1.4.0)

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
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1 Scope

This document defines the stage-2 service description for the IP Multimedia (IM) Subsystem, which includes the elements necessary to support IP Multimedia (IM) services in UMTS. CCITT I.130 [29] describes a three-stage method for characterisation of telecommunication services, and CCITT Q.65 [31] defines stage 2 of the method.

This document does not cover the Access Network functionality or GPRS aspects except as they relate to provision of IM services. GSM 03.64 [11] contains an overall description of the GSM GPRS Access Network. 3G TS 25.301 contains an overall description of the UMTS Terrestrial Radio Access Network.

2 References

[Editor's note: Chapter to be completed]

The following documents contain provisions, which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] TS 23.002: "Network Architecture".

[2] CCITT Recommendation E.164: "Numbering plan for the ISDN era".

[3] CCITT Recommendation Q.65: "Methodology – Stage 2 of the method for the characterization of services supported by an ISDN".

[4] IETF RFC 768 (1980): "User Datagram Protocol" (STD 6).

[5] IETF RFC 791 (1981): "Internet Protocol" (STD 5).

[6] IETF RFC 792 (1981): "Internet Control Message Protocol" (STD 5).

[7] IETF RFC 793 (1981): "Transmission Control Protocol" (STD 7).

[8] IETF RFC 1034 (1987): "Domain Names – Concepts and Facilities" (STD 7).

[9] IETF RFC 1661 (1994): "The Point-to-Point Protocol (PPP)" (STD 51).

[10] IETF RFC 1542 (1993): "Clarification and Extensions for the Bootstrap Protocol".

[11] IETF RFC 2131 (1997): "Dynamic Host Configuration Protocol".

[12] IETF RFC 2373 (1998): "IP Version 6 Addressing Architecture".

[13] IETF RFC 2462 (1998): "IPv6 Stateless Address Auto-configuration".

3 Definitions, symbols and abbreviations

3.1 Definitions

Refer to TS 23.002 for the definitions of some terms used in this document.

For the purposes of the present document the following additional definitions apply.

Editor's Note: Additional definitions TBD.

IP-Connectivity Network: refers to any reference points in the architecture that provide IP connectivity between any two or more IP capable nodes; e.g. Gm, Gi, Mw. An example of an "IP-Connectivity Network" is GPRS.

3.2 Symbols

For the purposes of the present document the following symbols apply:

Ga	Charging data collection interface between a CDR transmitting unit (e.g., an SGSN or a GGSN) and a CDR receiving functionality (a CGF).
Gb	Interface between an SGSN and a BSS.
Gc	Interface between a GGSN and an HLR.
Gd	Interface between a SMS-GMSC and an SGSN, and between a SMS-IWMSC and an SGSN.
Gf	Interface between an SGSN and an EIR.
Gi	Reference point between GPRS and an external packet data network.
Gn	Interface between two GSNs within the same PLMN.
Gp	Interface between two GSNs in different PLMNs. The Gp interface allows support of GPRS network services across areas served by the co-operating GPRS PLMNs.
Gr	Interface between an SGSN and an HLR.
Gs	Interface between an SGSN and an MSC/VLR.
Iu	Interface between the RNS and the core network. It is also considered as a reference point.
kbit/s	Kilobits per second.
Mbit/s	Megabits per second. 1 Mbit/s = 1 million bits per second.
R	Reference point between a non-ISDN compatible TE and MT. Typically this reference point supports a standard serial interface.
Reporting Area	The service area for which an MS's location shall be reported.
Service Area	The location accuracy level needed for service management purposes in the 3G-SGSN, e.g., a routing area or a cell. The 3G-SGSN can request the SRNC to report: i) the MS's current service area; ii) when the MS moves into a given service area; or iii) when the MS moves out of a given service area.
Um	Interface between the mobile station (MS) and the GSM fixed network part. The Um interface is the GSM network interface for providing GPRS services over the radio to the MS. The MT part of the MS is used to access the GPRS services in GSM through this interface.
Uu	Interface between the mobile station (MS) and the UMTS fixed network part. The Uu interface is the UMTS network interface for providing GPRS services over the radio to the MS. The MT part of the MS is used to access the GPRS services in UMTS through this interface.

3.3 Abbreviations

For the purposes of the present document the following abbreviations apply. Additional applicable abbreviations can be found in GSM 01.04 [1].

BG	Border Gateway
CDR	Call Detail Record
CGF	Charging Gateway Functionality
CK	Cipher Key
CS	Circuit Switched
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
EGPRS	Enhanced GPRS

GGSN	Gateway GPRS Support Node
GTP	GPRS Tunnelling Protocol
GTP-C	GTP Control Plane
GTP-U	GTP User Plane
ICMP	Internet Control Message Protocol
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISP	Internet Service Provider
P-TMSI	Packet TMSI
PDN	Packet Data Network
PDP	Packet Data Protocol, e.g., IP
PDU	Protocol Data Unit
PPP	Point-to-Point Protocol
RA	Routing Area
RAB	Radio Access Bearer
RAI	Routing Area Identity
SGSN	Serving GPRS Support Node
TCAP	Transaction Capabilities Application Part
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
UTRAN	UMTS Terrestrial Radio Access Network

4 IP Multimedia Subsystem Concepts

Editor's Note: This chapter is an introduction to the TS. The text should provide information on the overall concept of the IM subsystem and IM services.

4.1 Relationship to CS and PS Domains

Editor's Note: This section should provide a discussion on the relationship of the IM Subsystem to other parts of the R00 system (e.g., dependency on PS Domain, roaming to CS Domain, etc.).

4.2 IM Services Concepts

Editor's Note: This section should provide a discussion on the concepts involved in IM Services (e.g., home service control vs. visited service control, 3rd party services, multimedia vs. voice, etc.).

4.2.1 VHE

4.2.1.1 Support of CAMEL

It shall be possible for an operator to offer access to services based on the CSE for its IM subsystem subscribers. This shall be supported by a CAP interface to the serving CSCF. It should be noted that there is no requirement for any operator to support CAMEL services for their IM subsystem subscribers or for inbound roamers.

It shall be possible for a home network to provide support for CAMEL based services to a subscriber roaming in a network that does not support CAMEL on the IM Subsystem or does not support the required CAMEL Version. To achieve this, the home operator may support the CAP capable serving CSCF in the home network. This requirement does not prevent support of a CAP capable serving CSCF in the visited network.

4.2.2 Service Platforms for IM Services

A service platform offering value added IM services resides either in the user's home network or in a third party location. The third party could be a network or simply a stand-alone service platform.

4.2.3 Home and Visited Service Control

In the IM subsystem, the service control scheme for offering services to roaming users is of hybrid nature. The control is enforced by elements residing either in the home network or in the visited network.

4.2.3.1 Support of Roaming Subscribers

The Release 2000 architecture shall be based on the principle that the service control for a roaming subscriber is designated by the Home network. The serving CSCF can be located either in the Home network (see Figure 4-1) or in the visited network (see Figure 4-2). This assignment of the serving CSCF is designated by the Home network during the registration of the UE at the visited network.

4.2.3.1.1 Serving CSCF in the Home Network

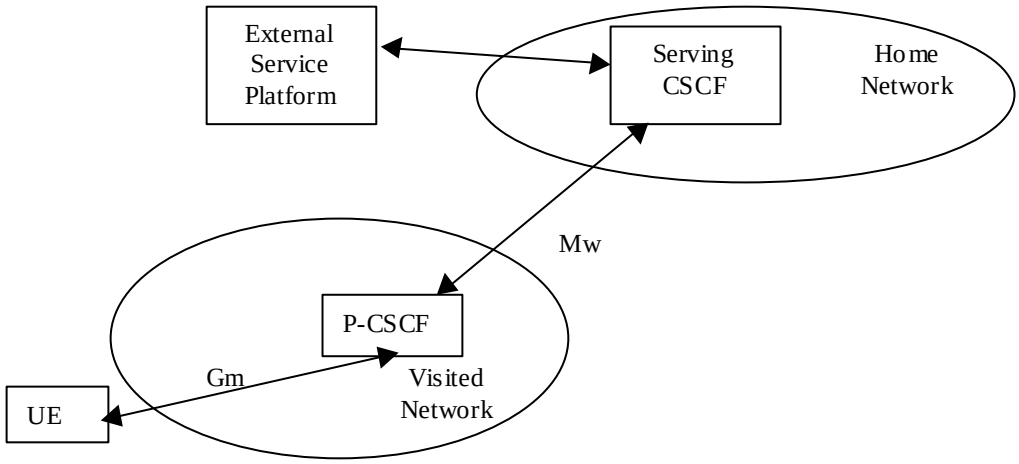


Figure 4-1: Serving CSCF in Home Network

In the case where the Serving CSCF is located in the Home Network, there are two possible scenarios to provide services:

- via the service platform in the Home Network
- via an external service platform (e.g. third party or visited network)

The box representing the external service platform could be located in either the visited network or in the 3rd party platform.

Editor's Note: the types of protocols to be used on the interfaces between the Serving CSCF and the different service platforms in these different scenarios are FFS.

4.2.3.1.2 Serving CSCF in the Visited Network

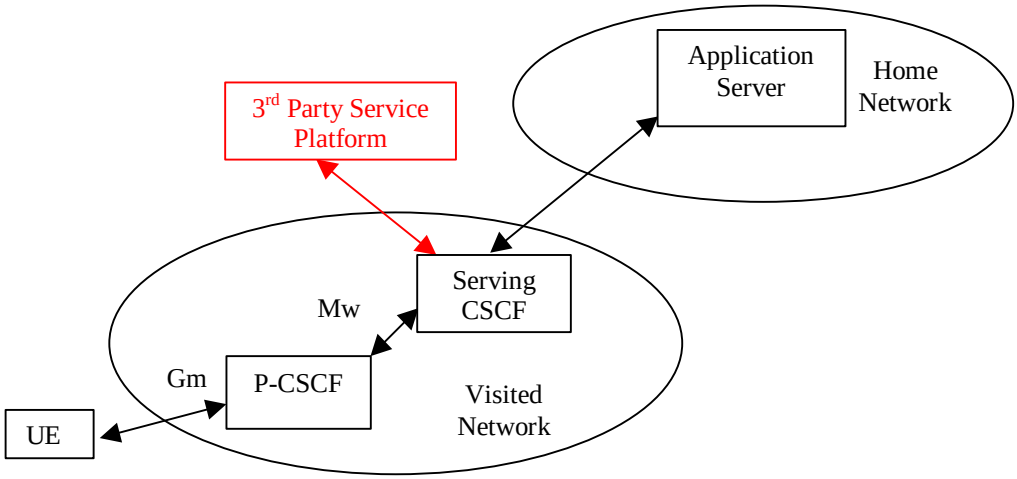


Figure 4-2: Serving CSCF in the Visited Network

In the case where the Serving CSCF is located in the Visited Network, there are three possible scenarios to provide services:

- via the service platform in the Home Network
- via the service platform in the Visited Network
- via a 3rd party service platform

When the S-CSCF and AS are in the same network, the specification for their interface is outside the scope of this group.

Editor's Note: the types of protocols to be used on the interfaces between the Serving CSCF and the different service platforms in these different scenarios are FFS.

4.2.3.1.3 Roles of the CSCFs in different roaming scenarios

The roles that the CSCF plays are described below.

- When subscribers roam to networks where serving CSCF is not offered, the roamed to (visited) network shall support a proxy CSCF. The proxy CSCF shall enable the call control to be passed to the home network based serving CSCF that shall provide service control.
- When subscribers roam to networks where a serving CSCF is offered but the home network decides to use a home network based serving CSCF, the roamed to (visited) network shall support a proxy CSCF. The proxy CSCF shall enable the call control to be passed to the home network based serving CSCF that shall provide service control.
- When subscribers roam to networks where a serving CSCF is offered and the home network decides to use the visited network based serving CSCF solution, the visited network serving CSCF may be used to provide service control to the roamed subscriber.

A Proxy CSCF shall be supported in both roaming and non-roaming case for home and visited service model, even when the serving CSCF is located in the same IM CN SS.

Reassigning the proxy CSCF assigned during CSCF discovery is not a requirement in Release 2000. Procedures to allow registration time proxy CSCF reassignment may be considered in future releases.

Network initiated proxy CSCF reassignment is not a requirement.

The use of additional CSCFs, that is Interrogating CSCFs, to be included in the SIP signaling path is optional. Such additional CSCFs may be used to shield the internal structure of a network from other networks.4.2.3.2 Assignment of Serving CSCF

The home network shall designate the serving CSCF in the home network or, with the help of the visited network, request a serving CSCF in the visited network. This selection is done on a per subscriber basis at registration time based on consideration of at least the following factors:

a) The service capabilities and toolkits supported by the visited network and the home network

b) The subscription profile of the subscriber.

4.2.4 CSCF to Service Platform Interface

This interface is used to provide services residing in a service platform. Five cases were identified:

- Serving CSCF in the Home Network to Service Platform in Home Network
- Serving CSCF in the Home Network to Service Platform in External Network (e.g., Third Party or Visited)
- Serving CSCF in the Visited Network to Service Platform in Home Network
- Serving CSCF in the Visited Network to Service Platform in Visited Network
- Serving CSCF in the Visited Network to Service Platform in Third Party Network

When the CSCF to Service Platform interface is within a single network, the interface is not standardised.

Three potential interfaces to provide services were identified:

- CAP: This interface provides CAMEL-based services offered on the CAMEL CSE platforms. They are invoked by a Service Switching Function (SSF) and supported by the CAP protocol. A “softSSF” in (or on top of) the CSCF is required for mapping of the SIP state machine in CSCF to the CAMEL BCSM. This interface allows support of legacy CAMEL services.
- SIP: This interface provides all services offered by SIP application servers and SIP-based Multimedia service platforms. These services are directly invoked by the CSCF as a SIP server itself. This interface shall not prevent the serving CSCF from retaining control of the call.
- OSA: This interface provides all applications that are independent from the underlying network technology, and are delivered via the use of an open standardised API. When the CSCF to Service Platform interface is between a network and a third party platform, the OSA API can be used as is. Conceptual changes may be needed if OSA has to be used as an interface between two networks, as it was not originally intended for this purpose. For example, the location of the OSA Framework may be impacted or the security mechanisms may be altered. The mapping of the OSA API to the underlying network capabilities is not subject to standardisation.

Editor's Note: The choice for standardisation of interfaces is FFS.

4.2.5 User versus Network Control of Services

4.2.6 The QoS Requirements for an IM Subsystem Call

The selection, deployment, initiation and termination of QoS signaling and resource allocation shall consider the following requirements so as to guarantee the QoS requirement associated with an IM subsystem call.

1. Independence between QoS signaling and Call Control

   The selection of QoS signaling and resource allocation schemes should be independent of the selected call control protocols. This allows for independent evolution of QoS control and the call control in the IM subsystem.

2. Necessity for End-to-End QoS Signaling and Resource -Allocation

   End-to-end QoS indication, negotiation and resource allocation during the call set-up in the IM subsystem should be enforced for those services and applications that require QoS better than best-effort services or the Background QoS Class.

3. QoS Signaling at Different Bearer Service Control Levels

During the call set-up in a IM subsystem, at least two levels of QoS signaling/negotiation and resource allocation should be included in selecting and setting up an appropriate bearer for the call:

1. The QoS signaling/negotiation and resource allocation at the IP Bearer Service (BS) Level:

   The QoS signaling and control at IP BS level is to pass and map the QoS requirements at the IP Multimedia application level to the UMTS BS level and performs any required end-to-end QoS signalling by inter-working with the external network. The IP BS Manager at the UE and the GGSN is the functional entity to process the QoS signalling at the IP BS level.

2. The QoS signalling/negotiation and resource allocation at the UMTS Bearer Service Level:

   The QoS signalling at the UMTS BS Level is to deliver the QoS requirements from the UE to the RAN, the CN, and the IP BS manager, where appropriate QoS negotiation and resource allocation are activated accordingly. When UMTS QoS negotiation mechanisms are used to negotiate end-to-end QoS, the translation function in the GGSN shall co-ordinate resource allocation between UMTS BS Manager and the IP BS Manager.

3. Interactions (QoS class selection, mapping, translation as well as reporting of resource allocation) between the QoS signaling/control at the IP BS Level and the UMTS BS Level take place at the UE and the GGSN which also serve as the interaction points between the IM Subsystem call control and the UMTS Bearer QoS control.

4. UMTS specific QoS signalling, negotiation and resource allocation mechanisms (e.g. RAB QoS negotiation and PDP Context set-up) shall be used at the UMTS BS Level. Other QoS signalling mechanisms such as RSVP at the IP BS Level shall only be used at the IP BS Level.

   It shall be possible to negotiate a single resource allocation at the UMTS Bearer Service Level and utilize it for multiple sessions at the IP Bearer Service Level.

4. Restricted Resource Access at the IP BS Level

   Access to the resources and provisioning of QoS at IP BS Level should be authenticated and authorized by applying appropriate QoS policies via the IP Policy Control element

5. Restricted Resource Access at the UMTS BS Level

   Access to the resources and provisioning of QoS at the UMTS BS Level should be authenticated and authorized by using existing UMTS registration/security/QoS policy control mechanisms.

6. Co-ordination between Call Control and QoS Signaling/Resource Allocation

   1. In establishing an IM session, it shall be possible for an application to request that the resources needed for bearer establishment be successfully allocated before the called user is alerted.

   2. In establishing an IM session, it shall be possible, dependent on the application being offered, to prevent the use of the bearer until the session establishment is completed.

   3. In establishing an IM session, it shall be possible for a terminating application to allow the called user to participate in determining which bearers shall be established.

   4. Successful bearer establishment shall include the completion of any required end-to-end QoS signalling, negotiation and resource allocation

   The initiation of any required end-to-end QoS signalling, negotiation and resource allocation processes at different network segments shall take place after the initiation and delivery of a session set-up request

7. The Efficiency of QoS Signaling and Resource Allocation

   The sequence of end-to-end QoS signalling, negotiation and resource allocation processes at different network segments should primarily consider the delay in negotiating end-to-end QoS and reserving resources that contributes to the call set-up delay. Parallel or overlapping QoS negotiation and resource reservation shall be allowed where possible.

8. Dynamic QoS Negotiation and Resource Allocation

Changes (upgrading or downgrading) of QoS provided to an active IM call shall be supported based on either the request from the IM application or the current network loads or radio link quality.

It shall be possible to maintain a resource allocation in excess of the resources needed for current media flows (but within the restrictions imposed by points #4 and #5 above), in order to e.g. switch to different media flow characteristics without risk of admission control failure.

9. Prevention of Theft of Service

   The possibility for theft of service in the IM domain shall be no higher than that for the corresponding GPRS and circuit switched services.

10. Prevention of Denial of Service

    The system unavailability due to denial of service attacks in the IM domain shall be no greater than that for the corresponding GPRS and circuit switched services.

4.3 Naming and Addressing Concepts

Editor's Note: This section should provide information on the naming used in the IP Multimedia Subsystem for users and for network nodes and how names are mapped into addresses (e.g., use of DNS etc.). Also should cover concepts for E.164 to IP mapping.

4.3.1 Address Management

The issues of IP address management are discussed in 23.221 [xx].

4.3.2 Addressing and Routing for Access to IM-Subsystem Services

NOTE: This section deals with a UE making access to IM-subsystem services only and via UMTS. How a UE can access IM subsystem services via other access types, or make simultaneous access to services in other IP networks is FFS.

A UE accessing IM-Subsystem services requires an IP address that is logically part of the Visited Network IM Subsystem IP Addressing Domain. This is established using an appropriate PDP-context. For routing efficiency this context should be connected though a GGSN in the visited network. The connection between the UE and the Visited Network IM Subsystem is shown below:

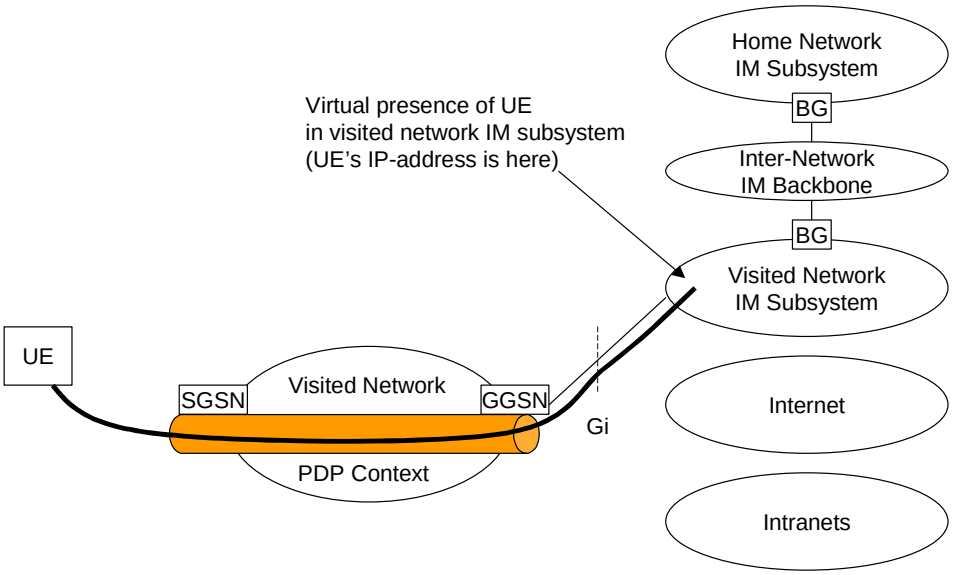


Figure 4-4 UE Accessing IM Subsystem Services in the visited network

4.3.3 Identification of Users

4.3.4 Identification of Network Nodes

4.3.5 Name to Address Resolution in an IM Subsystem

4.4 Signaling Concepts

A Single call control between the UE and CSCF. For Multi-Media type services delivered via the PS Domain within the R00 architecture, a single call control protocol shall be used between the user equipment UE and the CSCF (over the Gm reference point).

Protocols over the Gm reference point. The single protocol applied between the UE and CSCF (over the Gm reference point) within the R00 architecture will be based on SIP (as defined by RFC 2543, other relevant RFC's, and additional enhancements required to support 3GPP's needs).

A Single call control on the Mw, Mm, Mg. A single call control protocol shall be used on the call control interfaces between MGCF and CSCF, between CSCFs within one operator's network and between CSCFs in different operators' networks.

Protocols for the Mw, Mm, Mg. The single call control protocol applied to the interfaces between MGCF and CSCF, between CSCFs within one operator's network and between CSCFs in different operator's networks will be based on SIP (as defined by RFC 2543, other relevant RFC's, and additional enhancements required to support 3GPP´s needs).

UNI vs. NNI call control. The SIP based signalling interactions between CN elements may be different then SIP based signalling between the UE and the CSCF.

Network configuration hiding. It is a requirement that it shall be possible to hide the network topology from other operators. It shall be possible to restrict the following information from being passed outside of an operator's network: exact number of S-CSCFs, capabilities of S-CSCFs, or capacity of the network. Hiding requirements of P-CSCFs are for further study (Note that UE needs to have the address of P-CSCF).

Editor's Note: The material in this paragraph needs to be further clarified.

Restrict access from external networks. The signaling solution shall allow the operator to restrict access from external networks (application level).

Access to HSS. A network operator can control access to the HSS.

4.5 Mobility Related Concepts

4.5.1 Roaming between IM Subsystems

When a IM subsystem UE moves from one PLMN to another (or between one subnetwork and another – FFS), it should acquire a new IP address from the new (sub)network.

Note: An operator may decide to keep the user attached to a GGSN.

Using the current GPRS procedures,

- the UE shall release its current IP address in the previous network i.e. deactivate the PDP context supporting the SIP signalling
- the UE shall acquire a new IP address, i.e. activate a PDP context.
- the UE shall then execute the discovery and application level registration process to obtain SIP service from the new network.

If the IM Subsystem UE currently supports an active call/session , the UE shall delay the acquisition of a new IP address until that call/session has been terminated.

4.6 Roles of CSCF

4.6.1 Proxy CSCF

Proxy-CSCF (P-CSCF) is the first contact point within the IM subsystem. Its address is discovered by UEs following PDP context activation, using the mechanism described in section "Procedures related to Local CSCF Discovery ". The P-CSCF behaves like a proxy (as defined in RFC2543). The functions performed by the P-CSCF are:

- Forward the SIP register request received from the UE to an I-CSCF determined using the home domain name, as provided by the UE.
- Forward SIP messages received from the UE to the SIP server (e.g. S-CSCF) whose name the P-CSCF has received as a result of the registration procedure.
- As part of processing of the request and before forwarding, the P-CSCF may modify the Request URI of outgoing requests according to a set of provisioned rules defined by the network operator (e.g. Number analysis and potential modification such as translation from local to international format.)
- Forward the SIP request or response to the UE.

Editor's Note: The following functions require further study:

- Authorization of bearer resources and QoS management. Details of the P-CSCF role in QoS management and authorization of bearer resources for the session are being investigated by the QoS ad-hoc group.
- Security issues.
- The support of emergency calls in the visited network, and the role of the P-CSCF.
- Call monitoring and logging for roaming subscriber for e.g. billing verification, etc.

4.6.2 Interrogating CSCF

Interrogating-CSCF (**I-CSCF**) is the contact point within an operator's network for all connections destined to a subscriber of that network operator, or a roaming subscriber currently located within that network operator's service area. There may be multiple I-CSCFs within an operator's network. The functions performed by the I-CSCF are:

Registration

- assigning a S-CSCF to a user performing SIP registration (see section on Procedures related to Serving CSCF assignment)

Session Flows

- Route a SIP request received from another network towards the S-CSCF.
- Obtain from HSS the Address of the S-CSCF.
- Forward the SIP request or response to the S-CSCF determined by the step above
- Forward the SIP request or response to a MGCF for Optimal MGW assignment (Home Control of roamers).
- Forward the SIP request or response to an I-CSCF in another operator's network for Optimal MGW assignment (for third party PSTN termination)

In performing the above functions the operator may use I-CSCF or other techniques to hide the configuration, capacity, and topology of the its network from the outside. When the I-CSCF is chosen to meet the hiding requirement then for sessions traversing across different operators domains, I-CSCF may forward the SIP request or response to another I-CSCF allowing the operator to hide the S-CSCF address.

Editor's Note: Additional functions related to inter-operator security are for further study.

4.6.3 Serving CSCF

Serving-CSCF (**S-CSCF**) performs the session control services for the endpoint. It maintains session state as needed by the network operator for support of the services. Within an operator's network, different S-CSCFs may have different functionalities. The functions performed by the S-CSCF during a session are:

Registration

Acts like a Registrar defined in the RFC2543, i.e. it accepts Register requests and makes its information available through the location server (eg. HSS).

Session flows

- Session control for the registered endpoint's sessions.
- Interaction with Services Platforms for the support of Services
- On behalf of an originating endpoint (i.e. the originating subscriber/UE)
  - Obtain from a database the Address of the I-CSCF for the network operator serving the destination subscriber from the destination name of the terminating subscriber (e.g. dialled phone number or SIP URL), when the destination subscriber is a customer of a different network operator, and forward the SIP request or response to that I-CSCF.
  - Depending on operator policy, forward the SIP request or response to an I-CSCF in the subscriber's home network for PSTN terminated call, when the S-CSCF is performing visited network control.
  - When the destination name of the terminating subscriber (e.g. dialled phone number or SIP URL), and the destination subscriber is a customer of the same network operator, forward the SIP request or response to an I-CSCF within the operator's network.
  - Depending on operator policy, forward the SIP request or response to another SIP server located within an ISP domain outside of the IM subsystem.
- On behalf of a destination endpoint (i.e. the terminating subscriber/UE)
  - Forward the SIP request or response to a P-CSCF for a MT session to a home subscriber within the home network, or for a subscriber roaming within a visited network where the visited network operator has chosen not to have an I-CSCF in the path
  - Forward the SIP request or response to an I-CSCF for a MT session for a roaming subscriber within a visited network where the visited network operator has chosen to have an I-CSCF in the path.

Editor's Note: The following functions are for further study:

- Call monitoring and logging for e.g. billing, etc.
- Security issues

5 IP Multimedia Subsystem Procedures

Editor's note: this chapter discusses procedures specific to the IM Subsystem

5.1 Network Interworking Procedures

5.1.1 Interworking With PSTN

5.1.2 Interworking With Internet

5.2 CSCF Related Procedures

5.2.1 Procedures related to Local CSCF Discovery

The Proxy CSCF discovery shall be performed after GPRS attach using one of the following mechanisms:

1. Use DHCP to provide the UE with the domain name of a proxy CSCF and the address of a domain name server that is capable of resolving the proxy CSCF name.
2. Transfer a proxy CSCF address within the PDP Context Activation signalling to the UE.

The second alternative shall be used for terminals not supporting DHCP.

5.2.2 Procedures related to Serving CSCF Assignment

5.2.2.1 Assigning a Serving CSCF for a subscriber

When a mobile subscriber becomes active (e.g. when terminal is powered on) and possibly when the subscriber moves, a CSCF shall be assigned to serve the subscriber.

There are two significant decision points in the process of assigning a CSCF to serve the subscriber. The first decision, denoted "D1", is the choice of whether the visited or home network is chosen for service control. The second decision, denoted "D2", is the choice of the particular S-CSCF assigned to serve the subscriber.

Decision "D1" is performed in the HSS of the home network. The following information is needed in the selection of home control versus visited network control:

1. The network capabilities of the visited network for roamers.
   This information is obtained from the visited network in the registration request (as per section 5.3.2)
2. Operator preference on a per-user bases
   This information is stored in the HSS
3. Subscriber service requirements
   This information is stored in the HSS.
4. Identification of the visited network
   This information is provided by the visited network in the registration request.
5. Operator policies related to the particular visited network identified above

Editor's Note: This is for further study.

Decision "D2" is performed in the I-CSCF of either the home network (for home control) or the I-CSCF of the visited network (for visited network control). The following information is needed in the selection of the S-CSCF:

1. Required capabilities for subscriber services
   This information is provided by the HSS.

2. Operator preference on a per-user basis (when D1 was home control)
   This information is provided by the HSS.

3. The name of the home network operator (when D1 was visited control)
   This information is provided by the UE via the home network.

4. Capabilities of individual S-CSCFs in the selected network
   This is internal information within the operator's network. This information may be used in decision D2, but is not required. This information is obtained by the D2 decision-making entity by methods for further study.

   Editor's Note: The method of obtaining this information needs further study.

5. Topological (i.e. P-CSCF) information of where the subscriber is located
   This is internal information within the operator's network. This information may be used in decision D2, but is not required. The P-CSCF name is received in the registration request. The topological information of the P-CSCF is obtained by the D2 decision-making entity by methods for further study.

   Editor's Note: The method of obtaining this information needs further study.

6. Topological information of where the S-CSCF is located
   This is internal information within the operator's network. This information may be used in decision D2, but is not required. This information is obtained by the D2 decision-making entity by methods for further study.

   Editor's Note: The method of obtaining this information needs further study.

7. Availability of S-CSCFs
   This is internal information within the operator's network. This information may be used in decision D2, but is not required. This information is obtained by the D2 decision-making entity by methods for further study.

   Editor's Note: The method of obtaining this information needs further study.

In order to support the decision points described above, it is required that the following types of information can be transferred between CSCF and HSS:

1. The Cx reference point shall support the transfer of *CSCF-UE security parameters* from HSS to CSCF.

   Editor's Note: unless SA3 defines a different method to support a secure association between UE and CSCF.

   - This allows the CSCF and the subscriber to communicate in a trusted and secure way (there is no à priori trust relationship between a subscriber and a CSCF)

   - The security parameters can be for example pre-calculated challenge-response pairs, or keys for an authentication algorithm, etc.

2. The Cx reference point shall support the transfer of *service parameters of the subscriber* from HSS to CSCF.

   - This may include e.g. supplementary service parameters, application server address, triggers etc.

   - Note: it has to be determined what parameters should be stored where depending on the service control model. It has also to be made clear what are the functionality of the application level and service level.

3. The Cx reference point shall support the transfer of *CSCF capability information* from CSCF to HSS.

   - This may include e.g. supported service set, protocol version numbers etc.

   - Note: the requirement has to be revisited in view of the choice of the service control model.

4. The Cx reference point shall support the transfer of *call signalling transport parameters* from CSCF to HSS. The requirement has to be revisited in view of the choice of the service control model.

- The HSS stores the signalling transport parameters and they are used for routing mobile terminated calls to the Serving CSCF.

- The parameters may include e.g. IP-address and port number of CSCF, transport protocol etc.

The information mentioned in items 1 – 4 above shall be transferred before the CSCF is able to serve the mobile subscriber. It shall also be possible to update this information while the CSCF is serving the subscriber, for example if new supplementary services are activated for the subscriber.

5.2.2.2 Cancelling the Serving CSCF assignment

When the subscriber deactivates the terminal or possibly when he moves, the Serving CSCF assignment shall be cancelled.

The Cx reference point shall support the indication of cancelling the CSCF assignment.

- It shall be possible to initiate cancelling by both the CSCF and the HSS

5.2.3 Procedures Related to Interrogating CSCF

The architecture shall support multiple I-CSCFs for each operator. A DNS-based mechanism for selecting the I-CSCF shall be used to allow requests to be forwarded to an I-CSCF based, for example, on the location or identity of the forwarding node.

5.3 Application Level Registration Procedures

5.3.1 Requirements considered for Registration

The following points are considered as requirements for the purpose of the registration procedures.

1. The architecture shall allow for the serving CSCFs to have different capabilities or access to different capabilities. E.g. a VPN CSCF or CSCFs in different stages of network upgrade.

2. The network operator shall not be required to reveal the internal network structure to another network. Association of the node names of the same type of entity and their capabilities and the number of nodes will be kept within an operator's network. However disclosure of the internal architecture shall not be prevented on a per agreement basis.

3. A network shall not be required to expose the explicit IP addresses of the nodes within the network (excluding firewalls and border gateways).

4. It is desirable that the UE will use the same registration procedure(s) within its home and visited networks.

5. It is desirable that the procedures within the network(s) are transparent to the UE, when it register with the IM CN subsystem with either its home or visited CSCF.

6. The serving CSCF understands a service profile and the address of the functionality of the proxy CSCF.

5.3.2 Registration flows

5.3.2.1 Requirements to Consider for Registration

The additional requirement for the registration information flow for this section is:

1. A serving CSCF is assigned at registration, this does not preclude additional serving CSCFs or change of CSCF at a later date.

Editor's Note: The additional CSCFs are for FFS.

5.3.2.2 Assumptions

The following are considered as assumptions for the registration procedures as described in subclause 5.3.2.3:

1. Radio bearers are already established for signalling and a mechanism exists for the first REGISTER message to be forwarded to the proxy.

2. The I-CSCF shall use the same mechanism in visited and home networks for determining the serving CSCF address based on the required capabilities. The I-CSCF obtains the name of the S-CSCF from its role as a S-CSCF selector (Figure and Figure 5-3) for the determination and allocation of the serving CSCF during registration.

3. The decision as to whether the S-CSCF for the registering subscriber shall be in the home network or the visited network is located in the HSS

4. The decision for selecting the S-CSCF for the subscriber in the network decided in assumption 3 is made in the I-CSCF.

5. A role of the I-CSCF is the S-CSCF selection.

5.3.2.3 Registration Information Flows

The registration procedures are separated into three information flows. The information flow in subclause 5.3.2.4, is the common initiation of the registration information flows; the information flow in subclause 5.3.2.5, is the case that the serving CSCF is selected to be in the home network; and the information flow in subclause 5.3.2.6, is the case that the serving CSCF is selected to be in the visited network.

In the case where the functional element is prefixed by a “h” it indicates that the functional element is located in the home network. In the case where the functional element is prefixed by a “v” it indicates that the functional element is located in the visited network. In the case where there isn’t a prefix to the functional element the functional element could be in either the visited network, the home network.

Editor's Note: In the following information flows, further work is required to identify the information elements related to credentials and possible additional processes require for authentication of the user and the messages.

Editor's Note: The preceding paragraph explaining the use of "h" and "v" prefixes should be moved to Annex A for the information flow template.

The S-CSCF selection is a role of the I-CSCF.

Editors Note: For the case whether the S-CSCF is in the visited network, and the visited network has chosen not to reveal the names/addresses of the S-CSCFs, the mechanism for further terminating session establishments to route to the S-CSCF from the I-CSCF is FFS.

In the information flows described in subclauses 5.3.2.4, 5.3.2.5 and 5.3.2.6, there is a mechanism to resolve a name and address. The text in the information flows indicates when the name-address resolution mechanism is utilised.

5.3.2.4 Registration Information Flow A: Start of registration – User not registered

The application level registration can be initiated after the registration to the access is performed, and after IP connectivity for the signalling has been gained from the access network. For the purpose of the registration information flows, the subscriber is considered to be always roaming. For subscribers roaming in their home network, the home network shall perform the role of the visited network elements and the home network elements.

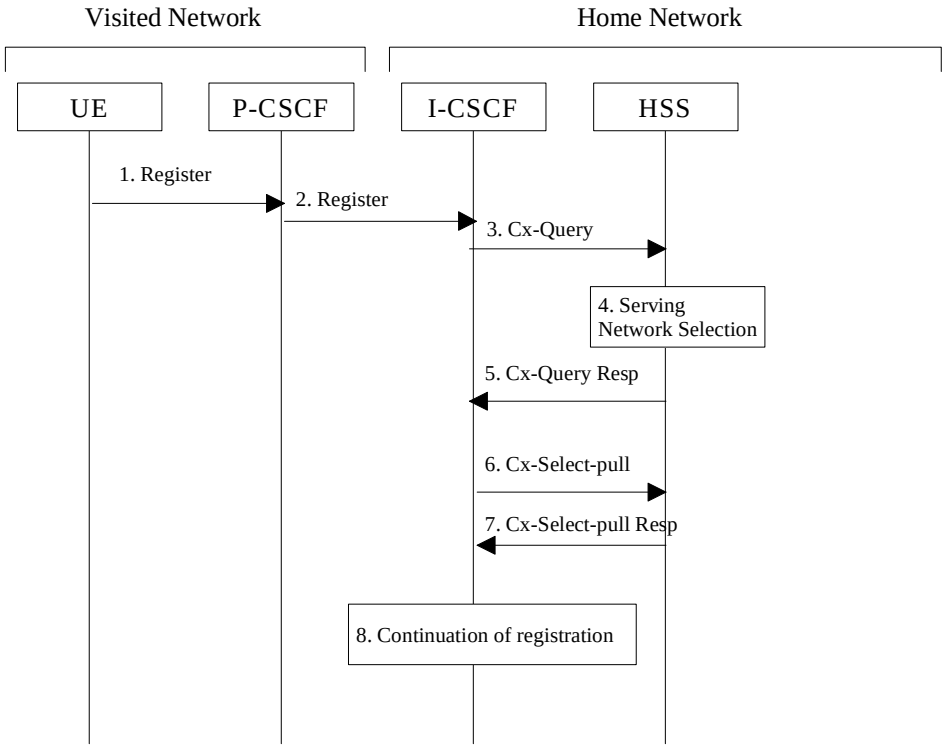


Figure 5-1 Start of Registration – User not registered

1. After the Ue has obtained a signalling channel through the access network, it can perform the IM registration. To do so, the Ue sends the Register information flow to the proxy (subscriber identity, home networks domain name).

2. Upon receipt of the register information flow, it shall examine the "home domain name" to discover the entry point to the home network (i.e. the I-CSCF). The proxy shall send the Register information flow to the I-CSCF (P-CSCFs "name" in the contact header, subscriber identity, visited network contact name). A name-address resolution mechanism is utilised in order to determine the address of the home network from the home domain name. When the I-CSCF receives the registration information flow from the proxy, it shall examine the subscriber identity and the home domain name, and employ the services of a name-address resolution mechanism, to determine the HSS address to contact.

3. The I-CSCF shall send the Cx-Query information flow to the HSS (P-CSCF name, subscriber identity, home domain name, visited network contact name). The P-CSCF name is the contact name that the operator wishes to use for future contact to that P- CSCF. (Editors Note: *It is FFS whether the terminal name, or proxy name, or both is included within this and subsequent register messages*). The Cx-query (P-CSCF name, subscriber identity, home domain name, visited network capabilities, visited network contact name) information flow is sent to the HSS.

4. The HSS shall check whether the user is registered already. The HSS shall indicate whether the user is allowed to register in that visited network according to the User subscription and operator limitations/restrictions if any. If the checking is successful, the HSS shall select whether the serving network is in the home network or the visited network

5. Cx-Query Resp (indication of serving network selection) is sent from the HSS to the I-CSCF. If the checking in HSS was not successful the Cx-Query Resp shall reject the registration attempt.

6. At this stage, it is assumed that the authentication of the user has been completed (although it may have been determined at an earlier point in the information flows). The I-CSCF shall send Cx-Select-Pull (serving network indication, subscriber identity) to the HSS to request the information related to the required S-CSCF capabilities which shall be input into the S-CSCF selection function.

7. The HSS shall send Cx-Select-Pull Resp (required S-CSCF capabilities) to the I-CSCF.

8. The registration information flows shall continue with the information flow shown in subclause 5.3.2.5 for the case of the S-CSCF being in the home network, or with the information flow shown in subclause 5.3.2.6 in the case the S-CSCF is in the visited network.

5.3.2.5 Registration Information Flow B: Continuation of Registration – S-CSCF in home network

The continuation of the registration flows for the S-CSCF in the home network is initiated after the reception of information flow 7 in subclause 5.3.2.4, and for the case that the home network has decided that the S-CSCF is to be in the home network.

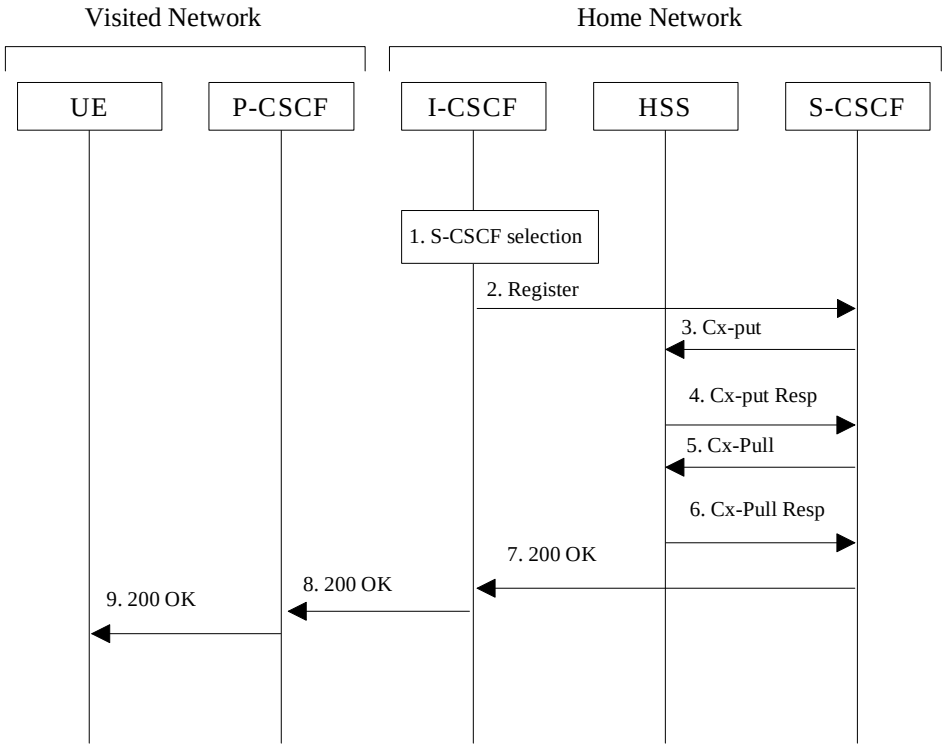


Figure 5-2 Continuation of Registration - serving CSCF in home network

1. The I-CSCF, using its role of the S-CSCF selection, shall determine the name of an appropriate S-CSCF.

2. The I-CSCF, using the name of the S-CSCF, shall determine the address of the S-CSCF through a name-address resolution mechanism and then shall send the register information flow (P-CSCFs “name” in the contact header, subscriber identity, visited network contact name,) to the selected S-CSCF.

3. The S-CSCF shall send Cx-Put (subscriber identity, S-CSCF name) to the HSS. The HSS stores the S-CSCF name for that subscriber.

4. The HSS shall send Cx-Put Resp to the I-CSCF to acknowledge the sending of Cx-Put.

5. On receipt of the Cx-Put Resp information flow, the S-CSCF shall send the Cx-Pull information flow (subscriber identity) to the HSS in order to be able to download the relevant information from the subscriber profile to the S-CSCF. The S-CSCF shall store the P-CSCFs name, as supplied by the visited network. This represents the name that the home network forwards the subsequent terminating session signalling to for the Ue.

6. The HSS shall returns the information flow Cx-Pull Resp (user information) to the S-CSCF. The S-CSCF shall store the it for that indicated user.

7. The S-CSCF shall determine whether the home contact name is the S-CSCF name or an I-CSCF name. If an I-CSCF is chosen as the home contact name, it may be distinct from the I-CSCF that appears in this registration

flow. The home contact name will be used by the P-CSCF to forward signalling to the home network. The S-CSCF shall return the 200 OK information flow (serving network contact name, S-CSCF name) to the I-CSCF.

8. The I-CSCF shall send information flow 200 OK (serving network contact name) to the P-CSCF. The I-CSCF shall release all registration information after sending information flow 200 OK.

9. The P-CSCF shall store the serving network contact name, and shall send information flow 200 OK to the Ue.

5.3.2.6 Registration Information Flow C: Continuation of Registration – S-CSCF in visited network

The continuation of the registration flows for the S-CSCF in the visited network is initiated after the reception of information flow 7 in subclause 5.3.2.4, and for the case that the home network has decided that the S-CSCF is to be in the visited network.

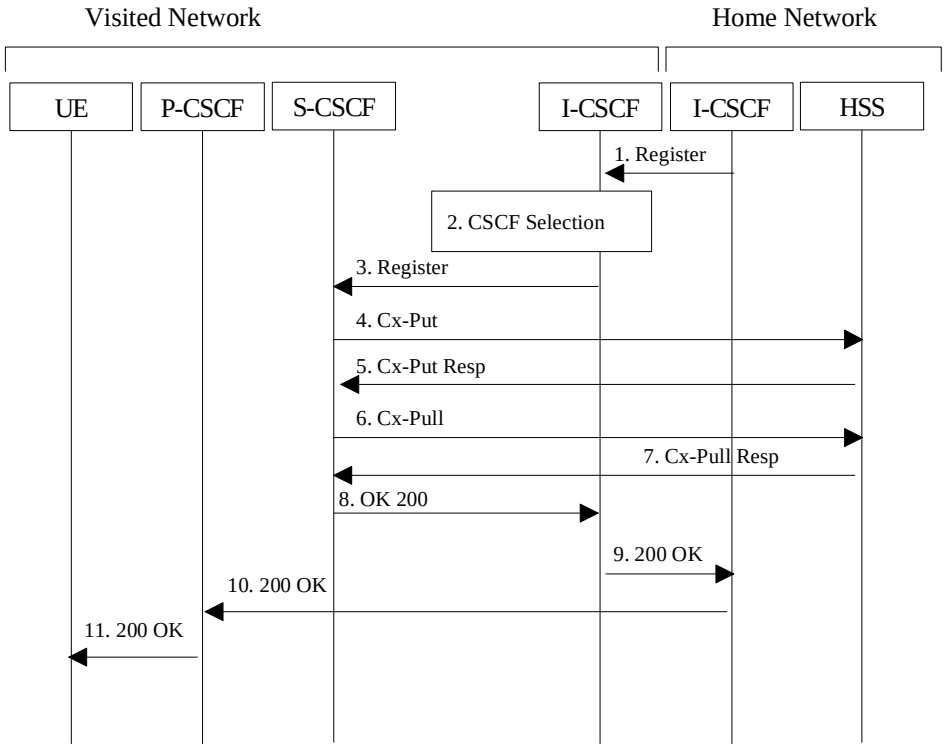


Figure 5-3 Continuation of Registration - serving CSCF in visited network

1. The hI-CSCF shall determine the address of the vI-CSCF from the visited network contact name using a name-address resolution mechanism and shall send the information flow register (P-CSCFs "name" in the contact header, required S-CSCF capabilities, subscriber identity,) to the vI-CSCF.

2. The vI-CSCF, using the role of the S-CSCF selection, shall determine the name of an appropriate S-CSCF.

3. The vI-CSCF, using the name of the S-CSCF, shall determine the address of the S-CSCF through a name-address resolution mechanism and then shall send the register information flow (P-CSCFs "name" in the contact header, subscriber identity, visited network contact name) to the selected S-CSCF.

4. The S-CSCF shall send Cx-Put (subscriber identity, S-CSCF name) to the HSS. The HSS stores the S-CSCF name for that subscriber.

5. The HSS shall send Cx-Put Resp to the vI-CSCF to acknowledge the sending of Cx-Put. (Editors Note: *The means for the visited network to located the serving S-CSCF in the visited network is FFS).*

6. On receipt of the Cx-Put Resp information flow, the S-CSCF shall send the Cx-Pull information flow (subscriber identity) towards the HSS in order to be able to download the relevant information of the subscriber profile to the S-CSCF. The S-CSCF shall store the P-CSCFs name.

7. The HSS shall return the information flow Cx-Pull Resp (user information) to the S-CSCF. The S-CSCF shall store the it for that indicated user.

8. The S-CSCF shall determine whether the serving contact name for the P-CSCF is the S-CSCF name or the vI-CSCF name. The serving contact name shall be used as the destination of session initiation signalling from the Ue towards the network hosting the S-CSCF. The S-CSCF shall return the 200 OK information flow (serving network contact name, S-CSCF name) to the vI-CSCF.

9. The vI-CSCF shall send the information flow 200 OK (serving network contact name) to the hI-CSCF. The vI-CSCF shall releases all registration information after sending information flow 200 OK.

10. The hI-CSCF shall sends information flow 200 OK (serving network contact name) to the P-CSCF. The hI-CSCF shall release all registration information after sending information flow 200 OK.

11. The P-CSCF shall store the serving network contact name, and shall send information flow 200 OK to the Ue.

5.3.2.7 Stored Information.

Table 5.1 provides an indication of the information stored in the indicated nodes during and after the registration process.

Node	Before Registration	During Registration	After Registration
UE - in local network	Credentials Home Domain		Credentials Home Domain Proxy Name/Address
Proxy CSCF - in local network	Routing Function	Network Entry point UE Address (Editors Note: *Supplies potential list of Visited Serving CSCFs is FFS*)	Network Entry point UE Address
Interrogating CSCF - in Home network	HSS Address	Serving CSCF address/name (Editors Note: Access to Potential list of Serving CSCFs is FFS)	No State Information
Interrogating CSCF (visited) - in visited network	HSS Address	Serving CSCF (visited) (Editors Note: Access to Potential list of serving CSCFs Is FFS)	No State Information
HSS	User Service Profile		Serving CSCF address/name Proxy address/name?
Serving CSCF (Home)	No state information	HSS Address/name Subscriber profile (limited – as per network scenario) Proxy address/name	May have call state Information HSS Address/name Subscriber information Proxy address/name
Serving CSCF (visited)	Local Service information No state information	HSS (Home) Address/name Subscriber profile (Limited – as per operator agreement) Proxy address/name	May have state Information HSS (home) Address/name Subscriber information (limited - as per operator agreement) Proxy address/name

Table 5.1 Information Storage before, during and after the registration process

5.4 Application Level De-registration Procedures

5.4.1 Mobile Initiated De-registration

5.4.2 Network Initiated De-registration

If an ungraceful session termination occurs (e.g. flat battery or mobile leaves coverage) when a stateful proxy server such as the S-CSCF is involved in a session memory leaks and eventually server failure can occur due to hanging state machines. To ensure stable S-CSCF operation and carrier grade service, a mechanism to handle the ungraceful session termination issue is required. This mechanism should be at the SIP protocol level in order to guarantee access independence for the IM domain.

5.5 Procedures for IP Multi-Media Sessions

Basic calls between mobile subscribers will always involve two S-CSCFs (one S-CSCF for each), which may be either in the home network or visited network. A basic call between a subscriber and a PSTN endpoint involves a S-CSCF for the UE and a MGCF for the PSTN.

The call flow is decomposed into three parts – an origination part, an inter-Serving-CSCF/MGCF part, and a termination part. The origination part covers all network elements between the UE (or PSTN) and the S-CSCF for that UE (or MGCF serving the MGW). The termination part covers all network elements between the S-CSCF for the UE (or MGCF serving the MGW) and the UE (or PSTN).

Annex <B.1> presents the overall structure for call flow procedures, and the list of procedures (origination, inter-serving, and termination) that are to be specified. This informative Annex is to be used as the basis for further work within SA2.

5.5.1 Requirements for IP Multi-Media Session Control

In order for operators to be able to offer a “carrier-grade” IP MM service, and considering that the network cannot trust the UE to give correct references to be put in the CDR or to require bearers whose features (e.g. Bandwidth) are coherent with the media components negotiated through CC, the following features shall be offered:

1. Both end points of the session shall be able to negotiate (according to service /UE settings,…) which resources (i.e. which media components) need to be established before called party is rung. Then the call signalling shall ensure that these resources (including (UMTS) IP-Connectivity Network resources and IP MM backbone resources) are made available or reserved before the called UE rings.

   This should nevertheless not prevent the UE from offering to the end-user the choice of accepting or rejecting the components of the session before establishing the bearers .

2. (Depending on regulatory requirements) the IPMM service shall be able to charge the calling party for the Access IP-connectivity service of both calling and called side or when reverse charging applies to charge the called party for the Access IP-connectivity service of both calling and called side. This implies that it should be easy to correlate CDR held by Access IP-connectivity service (e.g. GPRS) with a call.

3. The CC function of IP MM network of an operator (CSCF) shall be able (according to operator choice) to have a strict control (e.g. on source /destination IP address, QoS) on the flows associated with session established through SIP entering the IP MM bearer network from Access IP-connectivity service. This does not mean that CSCF is the enforcement point (which actually is the Gateway between the Access IP-connectivity service and the IP MM network, i.e. the GGSN in UMTS case) but that the CSCF may be the final decision point for this control.

4. The CC and bearer control mechanisms shall allow the CC to decide when user plane traffic between end-points of a SIP session may start /shall stop. This allows to let this traffic start / stop in synchronization with the start /stop of charging for a call.

5. The Access IP-connectivity service shall be able to notify the IP MM CC when Access IP-connectivity service has either modified or suspended or released the bearer(s) of an user associated with a call (because e.g. the user is no more reachable),

6. The solution shall comply with the architectural rules expressed in 23.121 sub-section “Separation between Bearer level, Call control level and Service level".

5.6 Serving-CSCF/MGCF to Serving-CSCF/MGCF Procedures

Annex <B.2> presents the detailed application level flows to define the procedures for Serving-CSCF to Serving-CSCF. This informative Annex is to be used as the basis for further work within SA2.

5.7 Origination Procedures

Annex <B.3> presents the detailed application level flows to define the Procedures for call originations. This informative Annex is to be used as the basis for further work within SA2.

5.8 Termination Procedures

Annex <B.4> presents the detailed application level flows to define the Procedures for call terminations. This informative Annex is to be used as the basis for further work within SA2.

5.9 Procedures related to routing information interrogation

The mobile terminated calls for a subscriber shall be routed either to a Serving CSCF or to a MGCF (if the subscriber is roaming in a legacy network). When a mobile terminated call set-up arrives at a CSCF that is authorised to route calls, the CSCF interrogates the HSS for routing information.

The Cx reference point shall support retrieval of routing information from HSS to CSCF

- The resulting routing information can be either Serving CSCF signalling transport parameters (e.g. IP-address).
- Note: the requirement has to be revisited in view of the choice of the service control model.

5.10 Routing of mid-call signaling

During the signaling exchanges that occur to establish an IM Session, the following elements must ensure future signaling messages related to this call are routed through them:

- P-CSCF serving the originating UE, in order to generate the CDR record in the roaming case, and to force release of the resources used for the call
- S-CSCF serving the originating UE, in order to perform any service control required at call completion, and to generate the CDR record at call termination
- S-CSCF serving the terminating UE, in order to perform any service control required at call completion, and to generate the CDR record at call termination
- P-CSCF serving the terminating UE, in order to generate the CDR record in the roaming case, and to force release of the resources used for the call

Other CSCFs (e.g. I-CSCFs) may optionally request this as well, for example if they perform some function needed in handling mid-call changes or call clearing operations.

All signaling message from the UE related to IM calls shall be sent to the P-CSCF.

5.11 Call Clearing Procedures

5.12 Supplementary Services Procedures

5.12.1 Call Hold and Resume Procedures

This section gives information flows for the procedures for placing sessions on hold that were previously established by the mechanisms of sections 5.5, 5.6, 5.7, and 5.8, and resuming the session afterwards. Two cases are presented: mobile-to-mobile (UE-UE), and a UE-initiated hold of a UE-PSTN session.

For a multi-media session, it shall be possible to place a subset of the media streams on hold while maintaining the others.

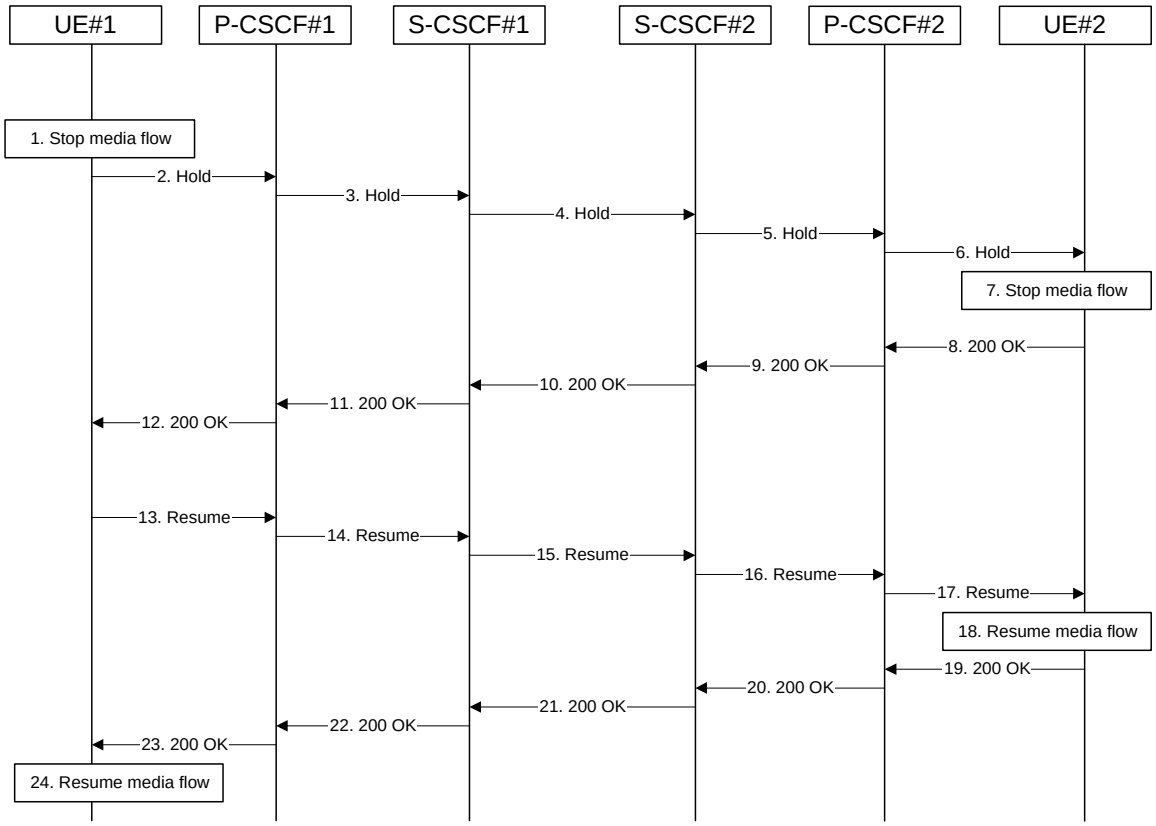
5.12.1.1 Mobile-to-Mobile Call Hold and Resume Procedures

A IM Session was previously established between an initiating UE and a terminating UE. Each of these UEs has an associated P-CSCF in the same network where they are currently located (either home or roaming), and a S-CSCF assigned either in their home network or, if roaming under visited control, in the visited network. These functional elements co-operate to clear the session, and the procedures are independent of whether they are located in the home or visited networks. Therefore there is no distinction in this section of home network vs. visited network.

The hold and resume procedures are identical whether the UE that initiated the session also initiates the call-hold, or whether the UE that terminated the session initiates the call-hold.

When a media stream has been placed on hold, it shall not be resumed by any endpoint other than the one that placed it on hold.

The procedures for placing a media stream on hold, and later resuming the media stream, are as shown in the following information flow:



Information flow procedures are as follows:

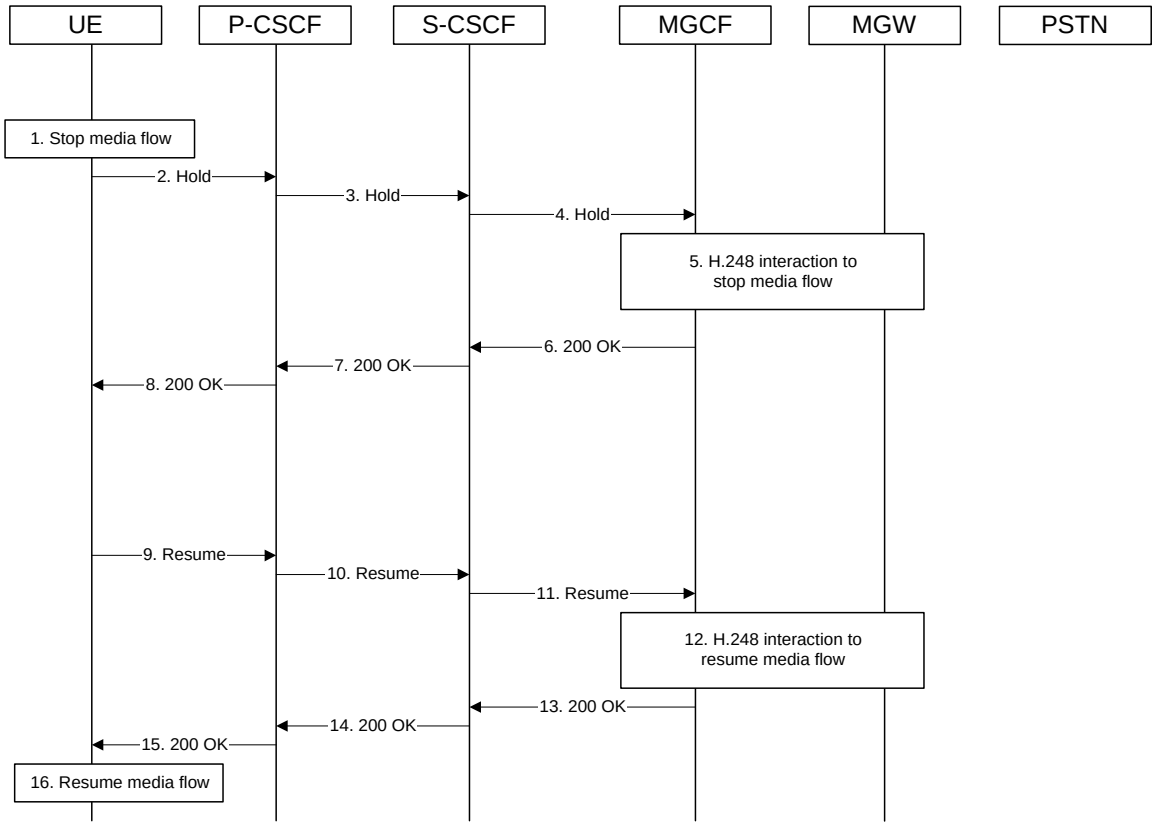
1. UE#1 detects a request from the subscriber to place a media stream on hold. UE#1 stops sending the media stream to the remote endpoint, but keeps the resources for the session reserved.
2. UE#1 sends a Hold message to its proxy, P-CSCF#1.
3. P-CSCF#1 forwards the Hold message to S-CSCF#1.
4. S-CSCF#1 forwards the Hold message to S-CSCF#2.
5. S-CSCF#2 forwards the Hold message to P-CSCF#2.
6. P-CSCF#2 forwards the Hold message to UE#2.
7. UE#2 stops sending the media stream to the remote endpoint, but keeps the resources for the session reserved.
8. UE#2 acknowledges receipt of the Hold message with a 200-OK final response, send to P-CSCF#2.
9. P-CSCF#2 forwards the 200 OK final response to S-CSCF#2.
10. S-CSCF#2 forwards the 200 OK final response to S-CSCF#1.
11. S-CSCF#1 forwards the 200 OK final response to P-CSCF#1.
12. P-CSCF#1 forwards the 200 OK final response to UE#1.
13. UE#1 detects a request from the subscriber to resume the media stream previously placed on hold. UE#1 sends a Resume message to its proxy, P-CSCF#1.
14. P-CSCF#1 forwards the Resume message to S-CSCF#1.
15. S-CSCF#1 forwards the Resume message to S-CSCF#2.
16. S-CSCF#2 forwards the Resume message to P-CSCF#2.
17. P-CSCF#2 forwards the Resume message to UE#2.
18. UE#2 resumes sending the media stream to the remote endpoint.
19. UE#2 acknowledges receipt of the Resume message with a 200-OK final response, sent to P-CSCF#2.
20. P-CSCF#2 forwards the 200 OK final response to S-CSCF#2.
21. S-CSCF#2 forwards the 200 OK final response to S-CSCF#1.
22. S-CSCF#1 forwards the 200 OK final response to P-CSCF#1.
23. P-CSCF#1 forwards the 200 OK final response to UE#1.
24. UE#1 resumes sending the media stream to the remote endpoint.

5.12.1.2 Mobile-initiated Hold and Resume of a Mobile-PSTN Session

A IM Session was previously established between an initiating UE and a MGCF acting as a gateway for a call terminating on the PSTN, or between an initiating MGCF acting as a gateway for a call originating on the PSTN to a terminating UE. The UE has an associated P-CSCF in the same network where it is currently located (either home or roaming), and a S-CSCF assigned either in its home network or, if roaming under visited control, in the visited network. These functional elements co-operate to clear the session, and the procedures are independent of whether they are located in the subscriber's home or visited networks. Therefore there is no distinction in this section of home network vs. visited network.

The call hold and resume procedure is identical whether the UE initiated the session to the PSTN, or if the PSTN initiated the call to the UE.

The procedures for placing a media stream on hold, and later resuming the media stream, are as shown in the following information flow:



Information flow procedures are as follows:

1. UE detects a request from the subscriber to place a media stream on hold. UE#1 stops sending the media stream to the remote endpoint, but keeps the resources for the session reserved.

2. UE sends a Hold message to its proxy, P-CSCF.

3. P-CSCF forwards the Hold message to S-CSCF.

4. S-CSCF forwards the Hold message to MGCF.

5. MGCF initiates a H.248 interaction with MGW instructing it to stop sending the media stream, but to keep the resources for the session reserved.

6. MGCF acknowledges receipt of the Hold message with a 200-OK final response, send to S-CSCF.

7. S-CSCF forwards the 200 OK final response to P-CSCF.

8. P-CSCF forwards the 200 OK final response to UE.

9. UE detects a request from the subscriber to resume the media stream previously placed on hold. UE sends a Resume message to its proxy, P-CSCF.

10. P-CSCF forwards the Resume message to S-CSCF.

11. S-CSCF forwards the Resume message to MGCF.

12. MGCF initiates a H.248 interaction with MGW instructing it to resume sending the media stream.

13. MGCF acknowledges receipt of the Resume message with a 200-OK final response, sent to S-CSCF.

14. S-CSCF forwards the 200 OK final response to P-CSCF.

15. P-CSCF forwards the 200 OK final response to UE.

16. UE resumes sending the media stream to the remote endpoint.

5.12.2 Procedures for Anonymous Calling

This section gives information flows for the procedures for anonymous calling. However, calls are not intended to be anonymous to the originating or terminating network operators.

5.12.2.1 Signaling Requirements for Anonymous Calling

If the subscriber requests the call to be anonymous, the UE must not reveal any identity information other than that required in the Remote-Party-ID header.

If the originating subscriber requests the call to be anonymous, the terminating side must not reveal any identity or signaling routing information to the destination endpoint. The terminating network should distinguish at least two cases, first where the originator intended the call to be anonymous, and second where the originator's identity was deleted by a transit network.

5.12.2.2 Bearer Path Requirements for Anonymous Calling

Editor's Note: This section is for further study.

Annex <A> (informative): Information Flow Template

This section describes the template used in developing information flow (IF) procedures.

X.Y.Z "Name of procedure (e.g., Terminal location registration)"

In this section, provide a brief prose description of the service or network capability. The "X.Y.Z." refers to the section heading number.

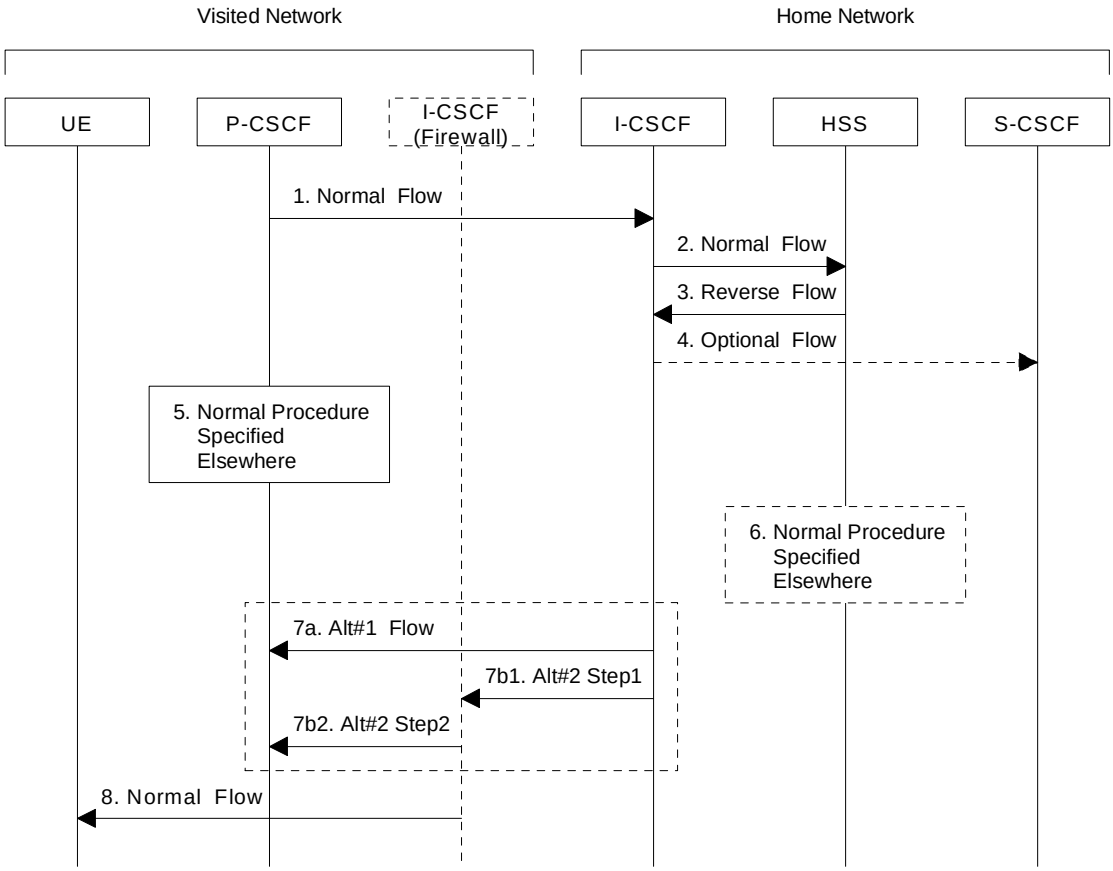


Figure X.V Information Flow Template

This sub-section consists of subparagraphs each dedicated to one information flow of the IF diagram. For each information flow, a detailed description is provided on the information flow name, certain information elements (IEs) within the information flow, whether the IE is mandatory or optional (M/O), in the sequence as shown in the IF diagram. FE actions (FEA) are also provided in this section. This sub-section format is proposed as follows:

1. Initial information flow: One should normally describe the initiating FE Action (FEA) leading to the first flow. Any information that is specifically required to support the operation should be mentioned (e.g. this flow conveys the subscriber identity to the HSS).

2. Each paragraph should contain a brief description of the flow and any specific start and end FEAs. When information to be conveyed is optional, the conditions for its inclusion should be specified and the response to its presence when received should also be specified (e.g., Include IP Address when condition xyz occurs). For an information flow that is required, the description should indicate whether a response is required based on successful outcome to the received IF, failed outcome, both or neither. e.g., "Response is required indicating Success or Failure".

3. Flows may occur in either direction but not both at the same time. To indicate a shorthand for multiple flows, use a procedure box as in flow 5 or 6.

4. Flows that are an optional part of the procedure should be shown as dotted arrows as in flow 4. These may appear in either direction.

5. A set of flows, representing a common procedure, is shown by a box. The procedure should be numbered and named with a name that corresponds to the procedure as described elsewhere. The location of the box on an entity represents the start of the common procedure regardless of the number of the entities involved in the procedure.

6. An optional set of flows is represented as a dashed box. Otherwise the use is the same as in flow 5.

7. A small number of alternative flows may be shown within a dashed box. The alternatives are shown by a letter immediately following the flow number, e.g. 7a, 7b, 7c, etc. Where a single alternative results in multiple flows, they must be shown with an indication of the proper sequence, e.g. 7b1, 7b2. The subparagraph describing the information flow must describe the decision process taken in choice of alternatives.

   7a. Alternative (a) is described. If alternative (a) is a single information flow, the contents and purpose of that information flow is included here.

   7b. Alternative (b) is described.

      7b1. The first information flow of alternative (b) is described

      7b2. The second information flow of alternative (b) is described. Etc.

8. The final flow in a procedure may provide additional information regarding other procedures that might follow it but such information is not required.

The general characteristics of the information flow template are as follows:

- All relevant functional entities are contained in the flow diagram. Only relevant entities need be shown.

- When an element occurs only in an information flows for which several alternatives exist, the description box for the functional entity and the vertical line shall be dashed lines.

- The specific network affiliation of functional entities may be shown using a labelled bracket over the specific entities as shown in the figure (e.g., Home Network). Such labelling is not required unless the flow would not be clear without it.

- The number associated with each flow provides a “handle” to the functional entity action (FEA) executed by the FE receiving the flow. This number is known only within the scope of the specific information flow diagram. The description of this functional entity action (FEA) immediately follows the information flow description.

- Common Procedures described elsewhere can be used in the information flows in order to simplify the diagram. These may be either required or optional.

- Each common procedure is treated as a single action and therefore is given a unique number.

- An optional flows (flows 4 and 6) are indicated by a dashed arrow or box.

- Co-ordinated flows or flows that illustrate parallel actions are indicated by the flow text description. For example one might see a description such as: "flows 5 and 6 may be initiated any time after flow 3".

- Sequential operation is assumed unless indicated otherwise.

Annex <B> (Informative): Sample end-end Call Flows

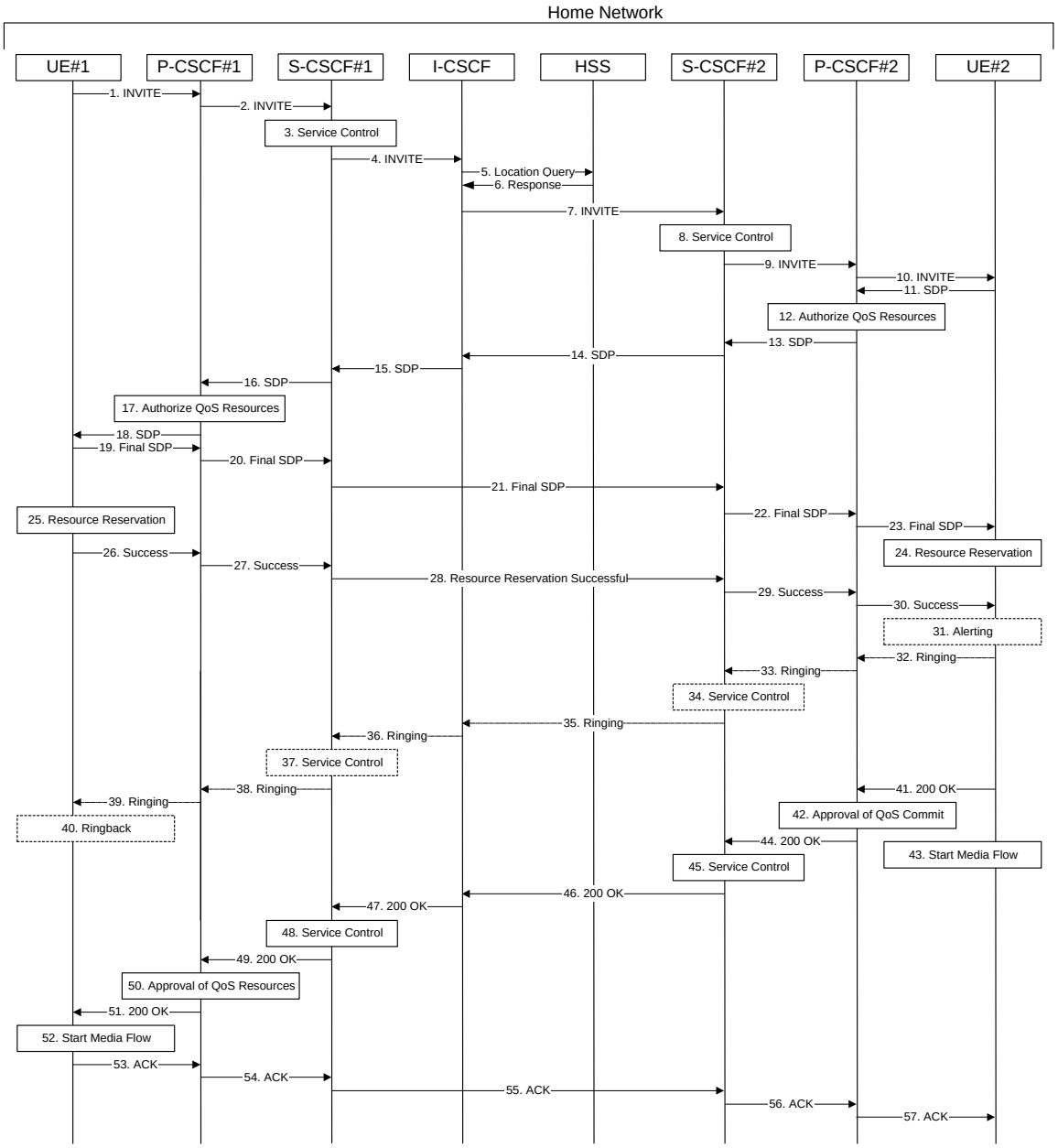
B.1 Sample end-end Call Flow - Mobile Origination/Termination

For this end-to-end call flow, we assume the originator is a mobile station located within the service area of the network operator to whom the mobile station is subscribed. The mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. As a result of registration, an S-CSCF has been chosen in the home network.

The calling party addresses a destination that is a subscriber of the same network operator.

The called party is a mobile station located within the service area of the network operator to which it is subscribed. This mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. As a result of registration, an S-CSCF was chosen in the home network.

B.1.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

1. UE#1 sends a SIP INVITE request, containing an initial SDP, to P-CSCF#1, which was obtained from the CSCF discovery procedures.

2. P-CSCF#1 forwards the INVITE to the next hop name/address, as determined from the registration procedures. In this case the next hop is S-CSCF#1 within the same operator's network.

3. S-CSCF#1 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

4. S-CSCF#1 translates the destination address and determines the call will be completed within the home operator's network. It therefore forwards the INVITE to I-CSCF#1.
5. I-CSCF#1 sends 'Cx-location-query' to the HSS to obtain the location information for the destination
6. The HSS responds with 'Cx-location-query-response' and indicates the destination is located in the home service area.
7. I-CSCF#1 forwards the INVITE to S-CSCF#2, which was identified by the HSS as serving this subscriber.
8. S-CSCF#2 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.
9. S-CSCF#2 remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE to P-CSCF#2 in the home network.
10. P-CSCF#2 remembers (from the registration procedure) the address of UE#2 and forwards the INVITE to UE#2.
11. UE#2 returns the media stream capabilities of the destination to the call originator, along the signaling path established by the INVITE message
12. P-CSCF#2 authorizes the QoS resources required for this session
13. P-CSCF#2 forwards the SDP to S-CSCF#2
14. S-CSCF#2 forwards the SDP to I-CSCF
15. I-CSCF forwards the SDP to S-CSCF#1
16. S-CSCF#1 forwards the SDP message to P-CSCF#1
17. P-CSCF#1 authorizes the resources necessary for this session
18. P-CSCF#1 forwards the SDP message to the originating endpoint, UE#1
19. The originator decides the final set of media streams for this session, and sends the Final SDP to P-CSCF#1
20. P-CSCF#1 forwards the final SDP to S-CSCF#1
21. S-CSCF#1 forwards the final SDP to S-CSCF#2. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.
22. S-CSCF#2 forwards the final SDP to P-CSCF#2
23. P-CSCF#2 forwards the final SDP to UE#2.
24. UE#2 initiates the resource reservation procedures for the resources necessary for this session.
25. After determining the final set of media streams for this session, step #19 above, UE#1 initiates the reservation procedures for the resources needed for this session
26. When UE#1 has successfully reserved the needed resources, it sends the "reservation successful" message to UE#2 along the signaling path established by the INVITE message. The message is sent first to P-CSCF#1.
27. P-CSCF#1 forwards the message to S-CSCF#1
28. S-CSCF#1 forwards the message to S-CSCF#2. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.
29. S-CSCF#2 forwards the message to P-CSCF#2
30. P-CSCF#2 forwards the message to UE#2.
31. UE#2 may optionally delay the session establishment in order to alert the subscriber to the incoming call.
32. If UE#2 performs alerting, it sends a ringing indication to the originator via the signaling path. The message is sent first to P-CSCF#2.

33. P-CSCF#2 forwards the ringing message to S-CSCF#2
34. S-CSCF#2 performs whatever service control is appropriate for this ringing call
35. S-CSCF#2 forwards the message to I-CSCF
36. I-CSCF forwards the message to S-CSCF#1
37. S-CSCF#1 performs whatever service control is appropriate for this ringing call.
38. S-CSCF#1 forwards the message to P-CSCF#1
39. P-CSCF#1 forwards the message to UE#1
40. UE#1 indicates to the originator that the session is being delayed due to alerting. Typically this involves playing a ringback sequence.
41. When the called party answers, UE#2 sends a SIP 200-OK final response along the signaling path back to the originator. The message is sent first to P-CSCF#2.
42. P-CSCF#2 approves the commitment of the QoS resources for this session
43. After sending the 200-OK, UE#2 initiates the media flow.
44. P-CSCF#2 forwards the final response to S-CSCF#2
45. S-CSCF#2 performs whatever service control is appropriate for this completed call.
46. S-CSCF#2 forwards the final response to I-CSCF
47. I-CSCF forwards the final response to S-CSCF#1
48. S-CSCF#1 performs whatever service control is appropriate for this completed call
49. S-CSCF#1 forwards the final response to P-CSCF#1
50. P-CSCF#1 approves the commitment of the QoS resources for this session
51. P-CSCF#1 forwards the final response to UE#1
52. UE#1 starts the media flow for this session
53. UE#1 responds to the final response with a SIP ACK message, which is passed to the destination via the signaling path. The message is sent first to P-CSCF#1.
54. P-CSCF#1 forwards the ACK to S-CSCF#1
55. S-CSCF#1 forwards the ACK to S-CSCF#2. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.
56. S-CSCF#2 forwards the ACK to P-CSCF#2
57. P-CSCF#2 forwards the ACK to UE#2

B.1.2 Call Flow Decomposition into Procedure Blocks

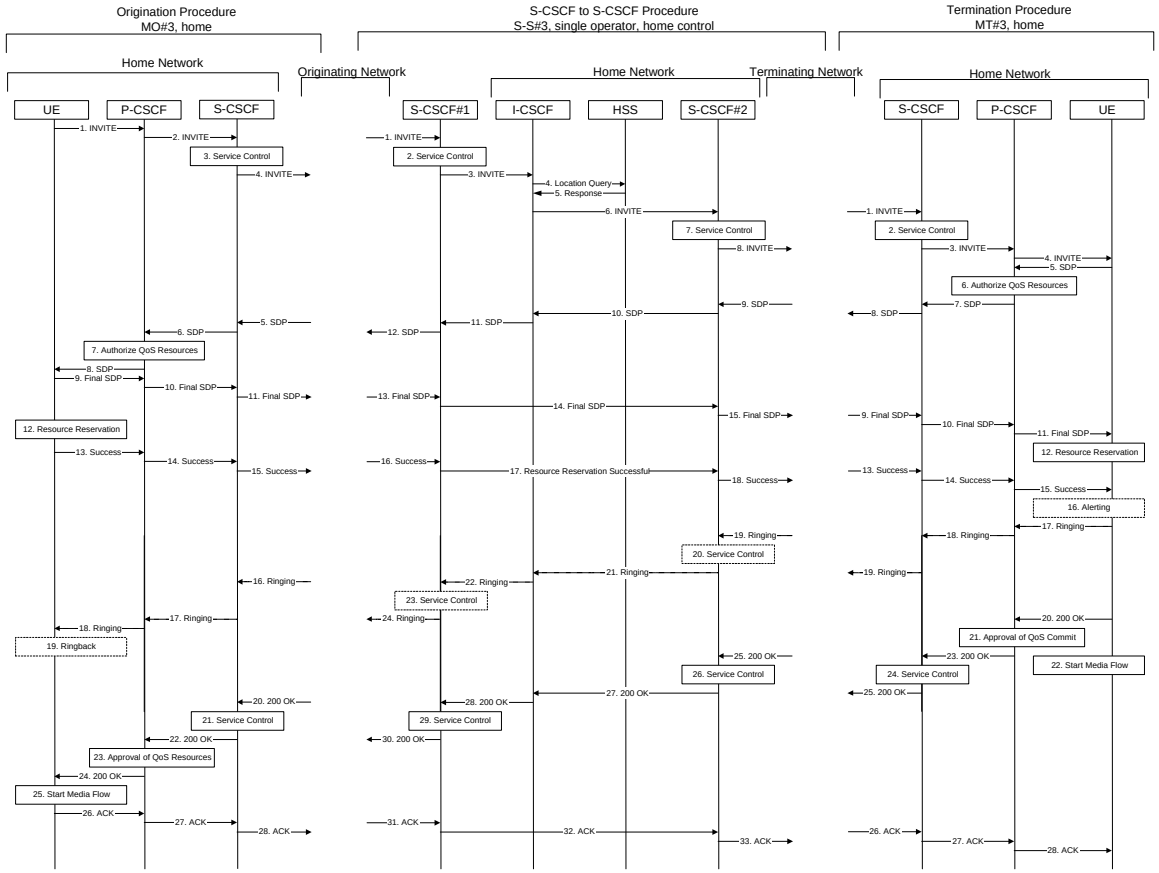
The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.3, *(MO#3) Mobile origination, located in home network.*

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.3, *(S-S#3) Single network operator performing origination and termination, with home control of termination.*

The terminating part is for a mobile termination, with subscriber located in the home operator service area. This procedure is given in Section 5.8.3, *(MT#3) Mobile termination, located in home network.*

The following diagram illustrates this decomposition, showing how the three separate procedures fit together to produce an end-to-end call flow.



B.1.3 Issues

The structure of the called party identity is not considered in the flow.

The mechanism by which the P-CSCF determines the next hop address (which in this case is the S-CSCF) requires further study.

S-CSCF#1 needs the ability to examine from whom the INVITE was sent (the calling party).

S-CSCF#2 needs the ability to determine the destination of the INVITE message.

I-CSCF needs the ability to determine the address of the HSS.

S-CSCF#2 needs the ability to examine from whom the INVITE was sent (the calling party)

S-CSCF#2 needs the ability to determine the destination of the INVITE message.

The mechanism by which S-CSCF#2 remembers the P-CSCF identity for the Called Party (discovered in the Registration process) requires further study.

The mechanism by which P-CSCF#2 remembers the identity of the Called Party (discovered in the registration process) requires further study.

It is assumed that S-CSCF#1 and S-CSCF#2 have the ability to carry out whatever service control is necessary

Authentication of the INVITE message is for further study

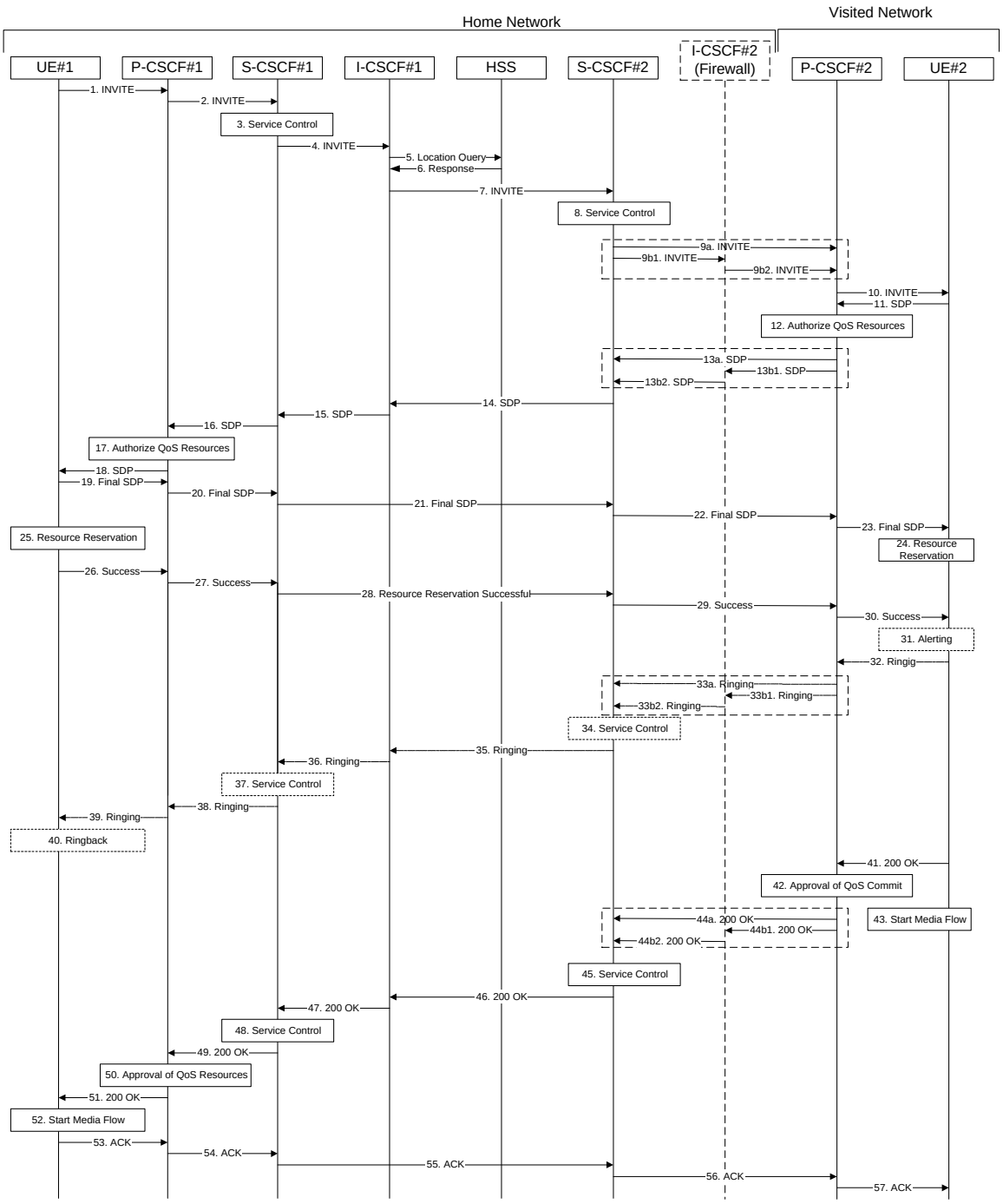
Security is not shown in the flow

B.2Sample end-end Call Flow - Mobile Origination, home, to Mobile Termination, roaming with home control. For this end-to-end call flow, we assume the originator is a mobile station located within the service area of the network operator to whom the mobile station is subscribed. The mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. As a result of registration, an S-CSCF has been chosen in the home network.

The calling party addresses a destination that is a subscriber of the same network operator.

The called party is a mobile station located in a service area of a network operator different from that of its service subscription. This mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. During registration, the home network operator chose to exercise home control, and an S-CSCF was chosen in the home network.

B.2.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

5. UE#1 sends a SIP INVITE request, containing an initial SDP, to P-CSCF#1, which was obtained from the CSCF discovery procedures.

6. P-CSCF#1 forwards the INVITE to the next hop name/address, as determined from the registration procedures. In this case the next hop is S-CSCF#1 within the same operator's network.

7. S-CSCF#1 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

8. S-CSCF#1 translates the destination address and determines the call will be completed within the home operator's network. It therefore forwards the INVITE to I-CSCF#1.

   5. I-CSCF#1 sends 'Cx-location-query' to the HSS to obtain the location information for the destination

6. The HSS responds with 'Cx-location-query-response' and indicates the destination is a roaming mobile station, under home network control.

7. I-CSCF#1 forwards the INVITE to S-CSCF#2, which was identified by the HSS as serving this subscriber.

8. S-CSCF#2 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

9. S-CSCF#2 remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE to P-CSCF#2 in the visited network, possibly through an I-CSCF. This next hop is either the P-CSCF that is serving the visiting UE (choice (a)), or an I-CSCF within the home network that is performing the configuration hiding function for the home network operator (choice (b)).

   (9a) If the home network operator does not desire to keep their network configuration hidden, the INVITE request is forwarded directly to P-CSCF#2.

   (9b) If the home network operator desires to keep their network configuration hidden, the INVITE request is forwarded through I-CSCF#2 to P-CSCF#2.

   (9b1) S-CSCF#2 forwards the INVITE request to I-CSCF#2 within the home network

   (9b2) I-CSCF#2 forwards the INVITE request to P-CSCF#2

10. P-CSCF#2 remembers (from the registration procedure) the address of UE#2, and forwards the INVITE to UE#2

11. UE#2 returns the media stream capabilities of the destination to the call originator, along the signaling path established by the INVITE message

12. P-CSCF#2 authorizes the QoS resources required for this session

13. P-CSCF#2 forwards the SDP to S-CSCF#2. Based on the choice made in (9) above, this response may either be sent directly from P-CSCF#2 to S-CSCF#2 (choice (a)), or be sent indirectly through I-CSCF#2 (firewall) (choice (b)).

14. S-CSCF#2 forwards the SDP to I-CSCF#1

15. I-CSCF#1 forwards the SDP to S-CSCF#1

16. S-CSCF#1 forwards the SDP message to P-CSCF#1

17. P-CSCF#1 authorizes the resources necessary for this session

18. P-CSCF#1 forwards the SDP message to the originating endpoint, UE#1

19. The originator decides the final set of media streams for this session, and sends the Final SDP to P-CSCF#1

20. P-CSCF#1 forwards the final SDP to S-CSCF#1

21. S-CSCF#1 forwards the final SDP to S-CSCF#2. This message may be routed through I-CSCF#1, depending on operator configuration of I-CSCF#1.

22. S-CSCF#2 forwards the final SDP to P-CSCF#2. This message may be routed through I-CSCF#2, depending on operator configuration of I-CSCF#2.

23. P-CSCF#2 forwards the final SDP to UE#2.

24. UE#2 initiates the resource reservation procedures for the resources necessary for this session.

25. After determining the final set of media streams for this session, step #19 above, UE#1 initiates the reservation procedures for the resources needed for this session

26. When UE#1 has successfully reserved the needed resources, it sends the "reservation successful" message to UE#2 along the signaling path established by the INVITE message. The message is sent first to P-CSCF#1.

27. P-CSCF#1 forwards the message to S-CSCF#1

28. S-CSCF#1 forwards the message to S-CSCF#2. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.

29. S-CSCF#2 forwards the message to P-CSCF#2. This message may be routed through I-CSCF#2, depending on operator configuration of I-CSCF#2.

30. P-CSCF#2 forwards the message to UE#2.

31. UE#2 may optionally delay the session establishment in order to alert the subscriber to the incoming call.

32. If UE#2 performs alerting, it sends a ringing indication to the originator via the signaling path. The message is sent first to P-CSCF#2.

33. P-CSCF#2 forwards the ringing message to S-CSCF#2. Based on the choice made in (9) above, this response may either be sent directly from P-CSCF#2 to S-CSCF#2 (choice (a)), or be sent indirectly through I-CSCF#2 (firewall) (choice (b)).

34. S-CSCF#2 performs whatever service control is appropriate for this ringing call

35. S-CSCF#2 forwards the message to I-CSCF

36. I-CSCF forwards the message to S-CSCF#1

37. S-CSCF#1 performs whatever service control is appropriate for this ringing call.

38. S-CSCF#1 forwards the message to P-CSCF#1

39. P-CSCF#1 forwards the message to UE#1

40. UE#1 indicates to the originator that the session is being delayed due to alerting. Typically this involves playing a ringback sequence.

41. When the called party answers, UE#2 sends a SIP 200-OK final response to P-CSCF#2

42. P-CSCF#2 approves the commitment of the QoS resources for this session

43. After sending the 200-OK, UE#2 initiates the media flow.

44. P-CSCF#2 sends a SIP 200-OK final response along the signaling path back toward the call originator. Based on the choice made in (9) above, this response may either be sent directly from P-CSCF#2 to S-CSCF#2 (choice (a)), or be sent indirectly through I-CSCF#2 (firewall) (choice (b)).

45. S-CSCF#2 performs whatever service control is appropriate for the completed call.

46. S-CSCF#2 sends a SIP 200-OK final response along the signaling path back to I-CSCF#1.

47. I-CSCF#1 sends a SIP 200-OK final response along the signaling path back to S-CSCF#1

48. S-CSCF#1 performs whatever service control logic is appropriate for this call completion

49. S-CSCF#1 sends a SIP 200-OK final response along the signaling path back to P-CSCF#1

50. P-CSCF#1 approves the commitment of the QoS resources for this session.

51. P-CSCF#1 sends a SIP 200-OK final response along the signaling path back to UE#1

52. UE#1 starts the media flow for this session

53. UE#1 responds to the final response with a SIP ACK message which is passed to UE#2 via the signaling path. The message is sent first to P-CSCF#1

54. P-CSCF#1 forwards the ACK to S-CSCF#1

55. S-CSCF#1 forwards the ACK to S-CSCF#2. This message may be routed through I-CSCF#1, depending on operator configuration of I-CSCF#1

56. S-CSCF#2 forwards the ACK to P-CSCF#2. This message may be routed through I-CSCF#2, depending on operator configuration of I-CSCF#2

57. P-CSCF#2 forwards the ACK to UE#2

B.2.2 Call Flow Decomposition into Procedure Blocks

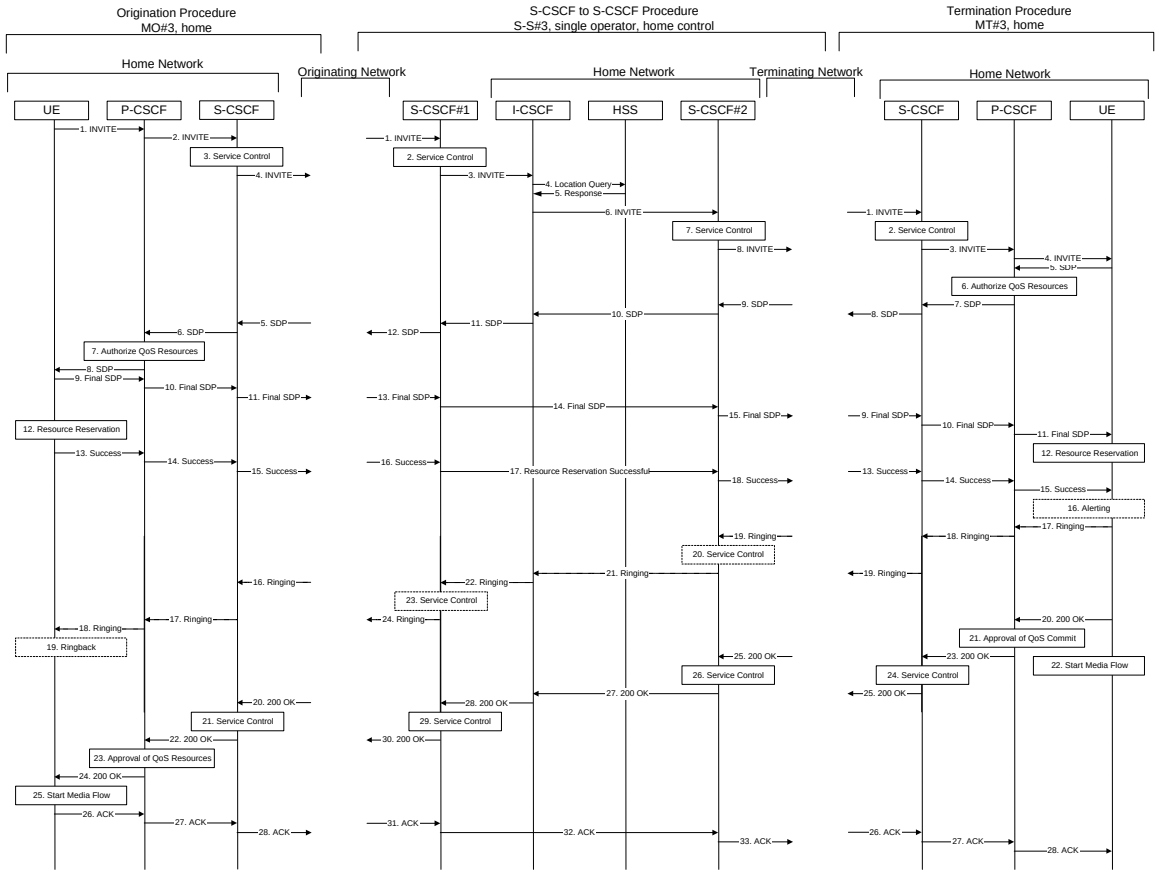
The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.3, *(MO#3) Mobile origination, located in home network.*

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.3, *(S-S#3) Single network operator performing origination and termination, with home control of termination*.

The terminating part is for a mobile termination, roaming, with home control.. This procedure is given in Section 5.8.1, *(MT#1) Mobile termination, roaming, with home control of services*..

The following diagram illustrates this decomposition, showing how the three separate procedures fit together to produce an end-to-end call flow.



B.2.3 Issues

None identified

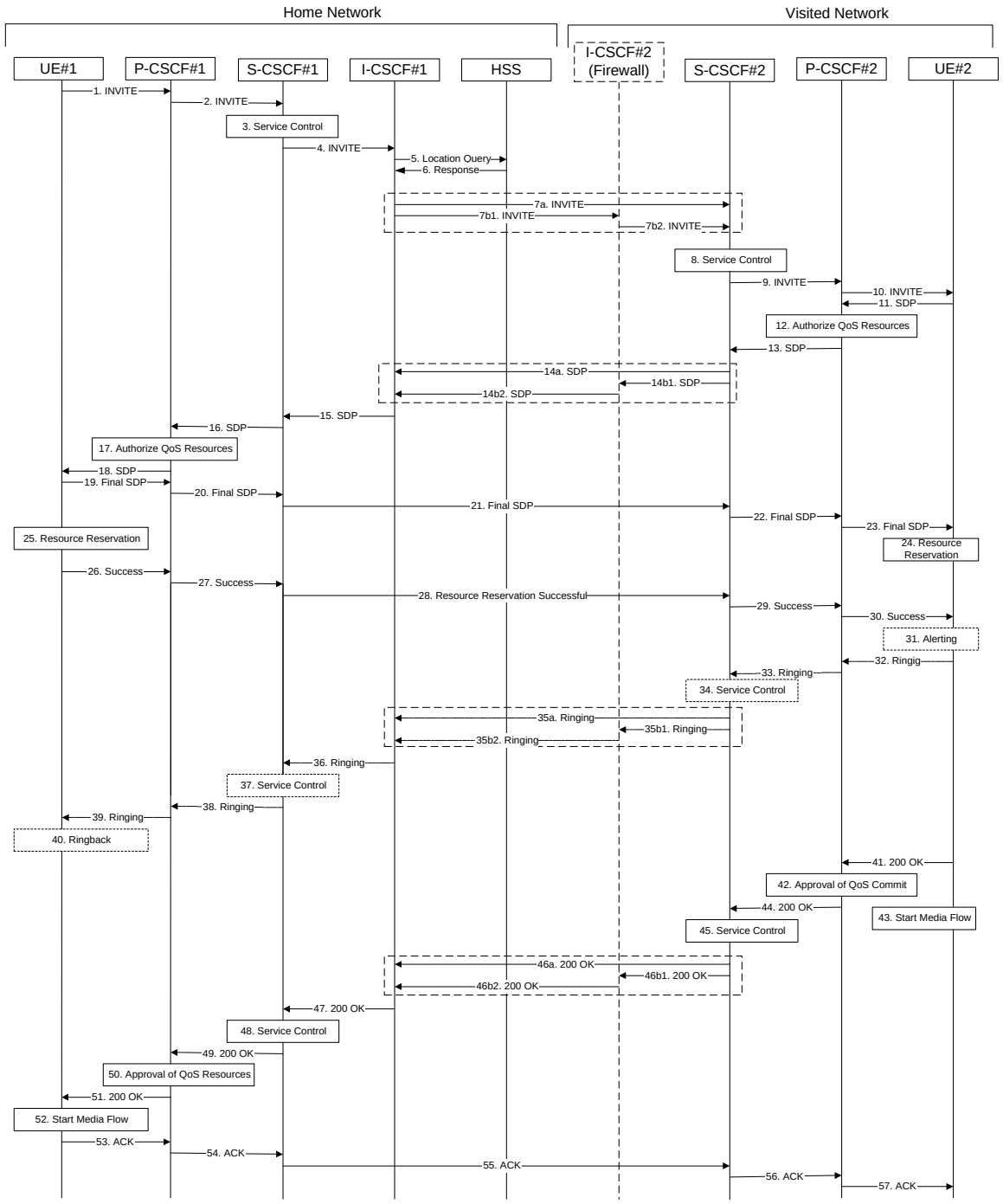
B.3 Sample end-end Call Flow - Mobile Origination, home, to Mobile Termination, roaming with visited control

For this end-to-end call flow, we assume the originator is a mobile station located within the service area of the network operator to whom the mobile station is subscribed. The mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. As a result of registration, an S-CSCF has been chosen in the home network.

The calling party addresses a destination that is a subscriber of the same network operator.

The called party is a mobile station located in a service area of a network operator different from that of its service subscription. This mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. During registration, the home network operator chose to let the visited network perform the call control, and an S-CSCF was chosen in the visited network.

B.3.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

1. UE#1 sends a SIP INVITE request, containing an initial SDP, to P-CSCF#1, which was obtained from the CSCF discovery procedures.

2. P-CSCF#1 forwards the INVITE to the next hop name/address, as determined from the registration procedures. In this case the next hop is S-CSCF#1 within the same operator's network.

3. S-CSCF#1 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

4. S-CSCF#1 translates the destination address and determines the call will be completed within the home operator's network. It therefore forwards the INVITE to I-CSCF#1.

5. I-CSCF#1 sends 'Cx-location-query' to the HSS to obtain the location information for the destination

6. The HSS responds with 'Cx-location-query-response' and indicates the destination is a roaming mobile station, under home network control.

7. I-CSCF#1 forwards the INVITE to the S-CSCF in the visited network, S-CSCF#2, possibly through an I-CSCF in the visited network. This next hop is either the S-CSCF that is serving the visiting UE (choice (a)), or an I-CSCF within the visited network that is performing the configuration hiding function for the visited network operator (choice (b)).

   (7a) If the visited network operator does not desire to keep their network configuration hidden, the INVITE request is forwarded directly to S-CSCF#2.

   (7b) If the home network operator desires to keep their network configuration hidden, the INVITE request is forwarded through I-CSCF#2 to S-CSCF#2.

      (7b1) I-CSCF#1 forwards the INVITE request to I-CSCF#2 within the visited network

      (7b2) I-CSCF#2 forwards the INVITE request to S-CSCF#2

8. S-CSCF#2 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

9. S-CSCF#2 remembers (from the registration procedure) the P-CSCF address, and forwards the INVITE to P-CSCF#2.

10. P-CSCF#2 remembers (from the registration procedure) the UE address, and forwards the INVITE to UE#2

11. UE#2 returns the media stream capabilities of the destination to the call originator, along the signaling path established by the INVITE message

12. P-CSCF#2 authorizes the QoS resources required for this session

13. P-CSCF#2 forwards the SDP to S-CSCF#2.

14. S-CSCF#2 forwards the SDP to I-CSCF#1. Based on the choice made in (7) above, this response may either be sent directly from S-CSCF#2 to I-CSCF#1 (choice (a)), or be sent indirectly through I-CSCF#2 (firewall) (choice (b)).

15. I-CSCF#1 forwards the SDP to S-CSCF#1

16. S-CSCF#1 forwards the SDP message to P-CSCF#1

17. P-CSCF#1 authorizes the resources necessary for this session

18. P-CSCF#1 forwards the SDP message to the originating endpoint, UE#1

19. The originator decides the final set of media streams for this session, and sends the Final SDP to P-CSCF#1

20. P-CSCF#1 forwards the final SDP to S-CSCF#1

21. S-CSCF#1 forwards the final SDP to S-CSCF#2. This message may be routed through I-CSCF#1 and/or I-CSCF#2, depending on operator configuration of I-CSCF#1 and I-CSCF#2.

22. S-CSCF#2 forwards the final SDP to P-CSCF#2.

23. P-CSCF#2 forwards the final SDP to UE#2.

24. UE#2 initiates the resource reservation procedures for the resources necessary for this session.

25. After determining the final set of media streams for this session, step #19 above, UE#1 initiates the reservation procedures for the resources needed for this session

26. When UE#1 has successfully reserved the needed resources, it sends the "reservation successful" message to UE#2 along the signaling path established by the INVITE message. The message is sent first to P-CSCF#1.

27. P-CSCF#1 forwards the message to S-CSCF#1

28. S-CSCF#1 forwards the message to S-CSCF#2. This message may be routed through I-CSCF#1 and/or I-CSCF#2, depending on operator configuration of I-CSCF#1 and I-CSCF#2.

29. S-CSCF#2 forwards the message to P-CSCF#2.

30. P-CSCF#2 forwards the message to UE#2.

31. UE#2 may optionally delay the session establishment in order to alert the subscriber to the incoming call.

32. If UE#2 performs alerting, it sends a ringing indication to the originator via the signaling path. The message is sent first to P-CSCF#2.

33. P-CSCF#2 forwards the ringing message to S-CSCF#2.

34. S-CSCF#2 performs whatever service control is appropriate for this ringing call

35. S-CSCF#2 forwards the message to I-CSCF#1. Based on the choice made in (7) above, this response may either be sent directly from S-CSCF#2 to I-CSCF#1 (choice (a)), or be sent indirectly through I-CSCF#2 (firewall) (choice (b)).

36. I-CSCF#1 forwards the message to S-CSCF#1

37. S-CSCF#1 performs whatever service control is appropriate for this ringing call.

38. S-CSCF#1 forwards the message to P-CSCF#1

39. P-CSCF#1 forwards the message to UE#1

40. UE#1 indicates to the originator that the session is being delayed due to alerting. Typically this involves playing a ringback sequence.

41. When the called party answers, UE#2 sends a SIP 200-OK final response to P-CSCF#2

42. P-CSCF#2 approves the commitment of the QoS resources for this session

43. After sending the 200-OK, UE#2 initiates the media flow.

44. P-CSCF#2 sends the SIP 200-OK final response along the signaling path to S-CSCF#2.

45. S-CSCF#2 performs whatever service control is appropriate for the completed call.

46. S-CSCF#2 sends a SIP 200-OK final response along the signaling path back toward the call originator. Based on the choice made in (7) above, this response may either be sent directly from S-CSCF#2 to I-CSCF#1 (choice (a)), or be sent indirectly through I-CSCF#2 (firewall) (choice (b)).

47. I-CSCF#1 sends the SIP 200-OK final response along the signaling path to S-CSCF#1

48. S-CSCF#1 performs whatever service control is appropriate for the completed call.

49. S-CSCF#1 sends a SIP 200-OK final response along the signaling path back to P-CSCF#1.

50. P-CSCF#1 approves the commitment of the QoS resources for this session.

51. P-CSCF#1 sends a SIP 200-OK final response along the signaling path back to UE#1

52. UE#1 starts the media flow for this session.

53. UE#1 responds to the final response with a SIP ACK message, which is passed to UE#2 via the signaling path. The message is sent first to P-CSCF#1

54. P-CSCF#1 forwards the ACK to S-CSCF#1

55. S-CSCF#1 forwards the ACK to S-CSCF#2. This message may be routed through I-CSCF#1 and/or I-CSCF#2, depending on operator configuration of I-CSCF#1 and I-CSCF#2.

56. S-CSCF#2 forwards the ACK to P-CSCF#2.

57. P-CSCF#2 forwards the ACK to UE#2.

B.3.2 Call Flow Decomposition into Procedure Blocks

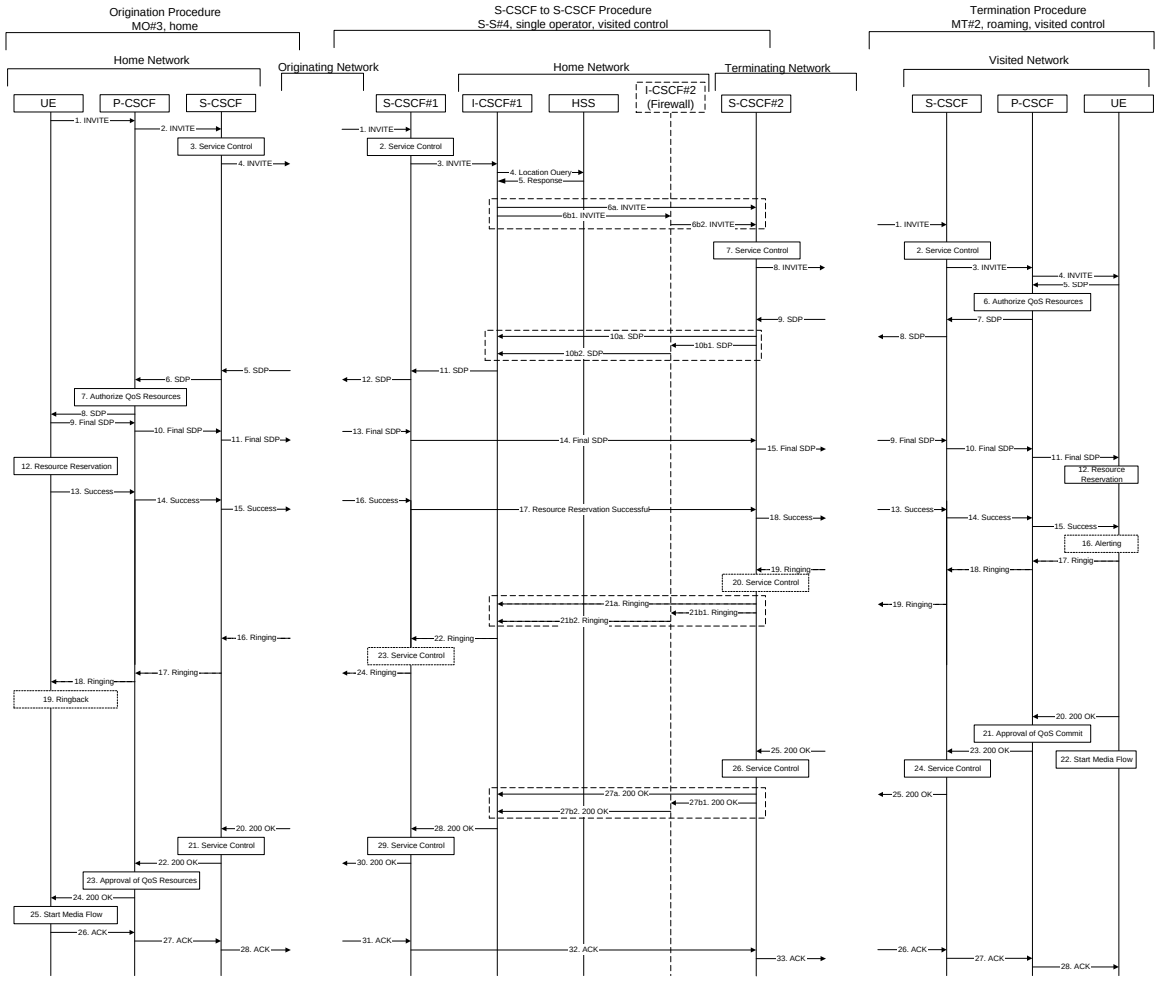
The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.3, *(MO#3) Mobile origination, located in home network.*

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.3, *(S-S#4) Call origination and termination are served by the same operator, termination is done by visited network control.*

The terminating part is for a mobile termination, roaming, with visited control. This procedure is given in Section 5.8.2, *(MT#2) Mobile termination, roaming, with visited network control of services.*

The following diagram illustrates this decomposition, showing how the three separate procedures fit together to produce an end-to-end call flow.



B.3.3 Issues

None identified

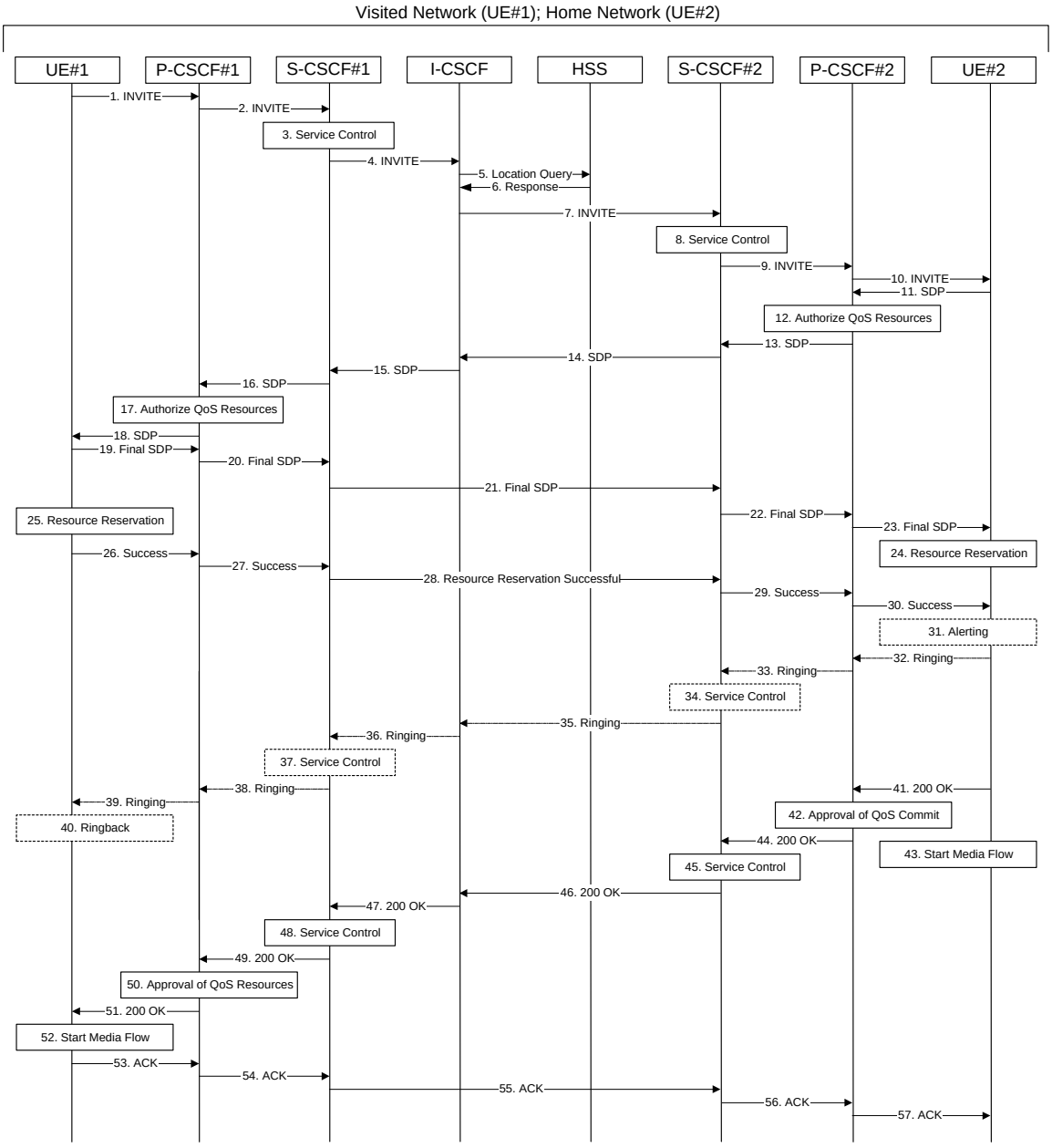
B.4 Sample end-end Call Flow - Mobile Origination, roaming with visited control, to Mobile Termination, home

For this end-to-end call flow, we assume the originator is a mobile station located outside the service area of the network operator to whom the mobile station is subscribed. The mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. During registration the home network operator chose to accept the offer of visited control, and an S-CSCF has been chosen in the visited network.

The calling party addresses a destination that is a subscriber of the same network operator, i.e. a subscriber of the network operator where the calling party is roaming.

The called party is a mobile station located within the service area of the network operator to which it is subscribed. This mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. As a result of registration, an S-CSCF was chosen in the home network.

B.4.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

1. UE#1 sends a SIP INVITE request, containing an initial SDP, to P-CSCF#1, which was obtained from the CSCF discovery procedures.
2. P-CSCF#1 remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE to S-CSCF#1, within the visited operator's network, utilizing the visited control.
3. S-CSCF#1 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.
4. S-CSCF#1 translates the destination address and determines the call will be completed within the same visited operator's network. It therefore forwards the INVITE to I-CSCF.
5. I-CSCF sends 'Cx-location-query' to the HSS to obtain the location information for the destination
6. The HSS responds with 'Cx-location-query-response' and indicates the destination is in the home service area.
7. I-CSCF forwards the INVITE to S-CSCF#2, identified by the HSS as serving this subscriber.
8. S-CSCF#2 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.
9. S-CSCF#2 remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE to P-CSCF#2, in the home network.
10. P-CSCF#2 remembers (from the registration procedure) the address of UE#2, and forwards the INVITE to UE#2
11. UE#2 returns the media stream capabilities of the destination to the call originator, along the signaling path established by the INVITE message
12. P-CSCF#2 authorizes the QoS resources required for this session
13. P-CSCF#2 forwards the SDP to S-CSCF#2.
14. S-CSCF#2 forwards the SDP to I-CSCF
15. I-CSCF forwards the SDP to S-CSCF#1
16. S-CSCF#1 forwards the SDP message to P-CSCF#1
17. P-CSCF#1 authorizes the resources necessary for this session
18. P-CSCF#1 forwards the SDP message to the originating endpoint, UE#1
19. The originator decides the final set of media streams for this session, and sends the Final SDP to P-CSCF#1
20. P-CSCF#1 forwards the final SDP to S-CSCF#1
21. S-CSCF#1 forwards the final SDP to S-CSCF#2. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.
22. S-CSCF#2 forwards the final SDP to P-CSCF#2.
23. P-CSCF#2 forwards the final SDP to UE#2.
24. UE#2 initiates the resource reservation procedures for the resources necessary for this session.
25. After determining the final set of media streams for this session, step #19 above, UE#1 initiates the reservation procedures for the resources needed for this session
26. When UE#1 has successfully reserved the needed resources, it sends the "reservation successful" message to UE#2 along the signaling path established by the INVITE message. The message is sent first to P-CSCF#1.
27. P-CSCF#1 forwards the message to S-CSCF#1
28. S-CSCF#1 forwards the message to S-CSCF#2. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.

29. S-CSCF#2 forwards the message to P-CSCF#2.
30. P-CSCF#2 forwards the message to UE#2.
31. UE#2 may optionally delay the session establishment in order to alert the subscriber to the incoming call.
32. If UE#2 performs alerting, it sends a ringing indication to the originator via the signaling path. The message is sent first to P-CSCF#2.
33. P-CSCF#2 forwards the ringing message to S-CSCF#2.
34. S-CSCF#2 performs whatever service control is appropriate for this ringing call
35. S-CSCF#2 forwards the message to I-CSCF
36. I-CSCF forwards the message to S-CSCF#1
37. S-CSCF#1 performs whatever service control is appropriate for this ringing call.
38. S-CSCF#1 forwards the message to P-CSCF#1
39. P-CSCF#1 forwards the message to UE#1
40. UE#1 indicates to the originator that the session is being delayed due to alerting. Typically this involves playing a ringback sequence.
41. When the called party answers, UE#2 sends a SIP 200-OK final response to P-CSCF#2
42. P-CSCF#2 approves the commitment of the QoS resources for this session
43. After sending the 200-OK, UE#2 initiates the media flow.
44. P-CSCF#2 sends a SIP 200-OK final response along the signaling path back to S-CSCF#2.
45. S-CSCF#2 performs whatever service control is appropriate for the completed call.
46. S-CSCF#2 sends a SIP 200-OK final response along the signaling path back to I-CSCF.
47. I-CSCF sends a SIP 200-OK final response along the signaling path back to S-CSCF#1.
48. S-CSCF#1 performs whatever service control logic is appropriate for this call completion
49. S-CSCF#1 sends a SIP 200-OK final response along the signaling path back to P-CSCF#1
50. P-CSCF#1 approves the commitment of the QoS resources for this session.
51. P-CSCF#1 sends a SIP 200-OK final response along the signaling path back to UE#1
52. UE#1 starts the media flow for this session.
53. UE#1 responds to the final response with a SIP ACK message, which is passed to UE#2 via the signaling path. This message is sent first to P-CSCF#1.
54. P-CSCF#1 forwards the ACK to S-CSCF#1
55. S-CSCF#1 forwards the ACK to S-CSCF#2. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.
56. S-CSCF#2 forwards the ACK to P-CSCF#2.
57. P-CSCF#2 forwards the ACK to UE#2.

B.4.2 Call Flow Decomposition into Procedure Blocks

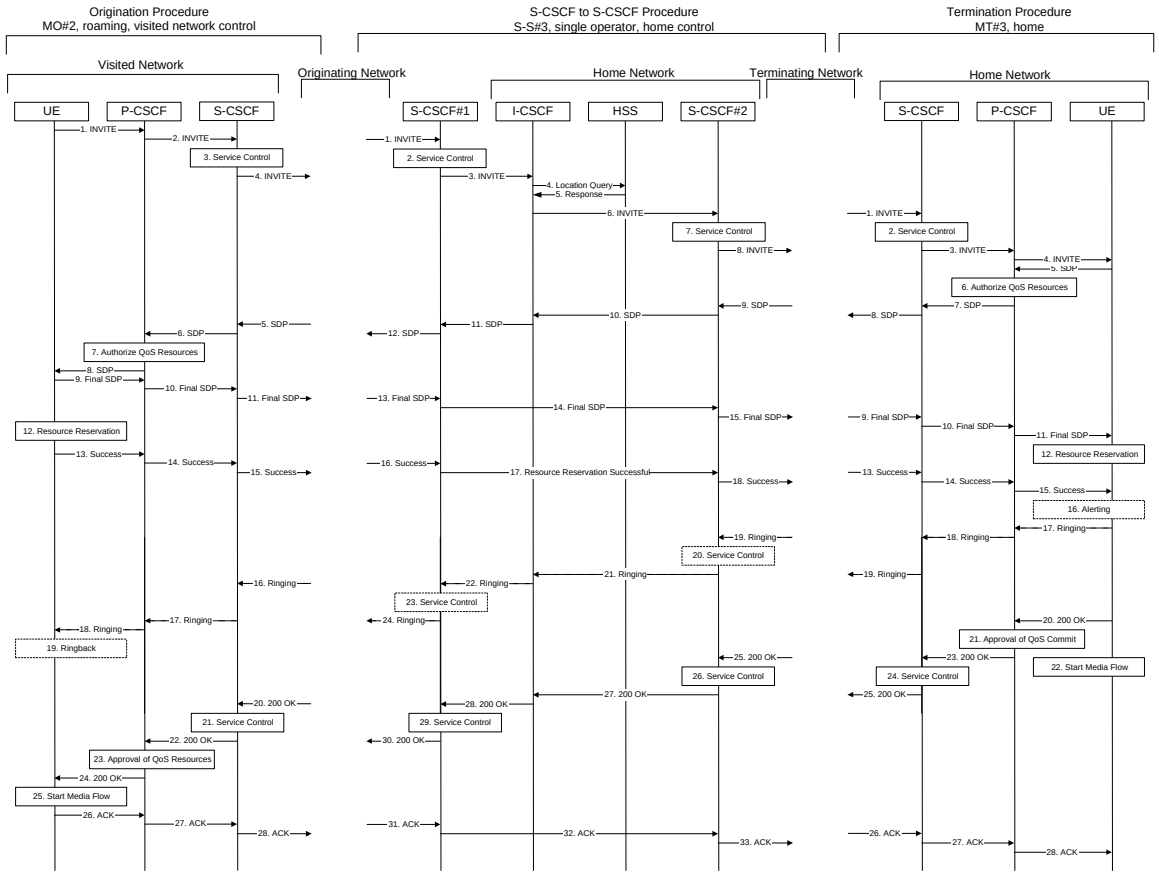
The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.2, *(MO#2) Mobile origination, roaming, with visited network control of services*.

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.3, *(S-S#3) Single network operator performing origination and termination, with home control of termination*.

The terminating part is for a mobile termination, with the subscriber located in the home operator service area. This procedure is given in Section 5.8.3, *(MT#3) Mobile termination, located in home network.*

The following diagram illustrates this decomposition, showing how the three separate procedures fit together to produce an end-to-end call flow.



B.4.3 Issues

None identified

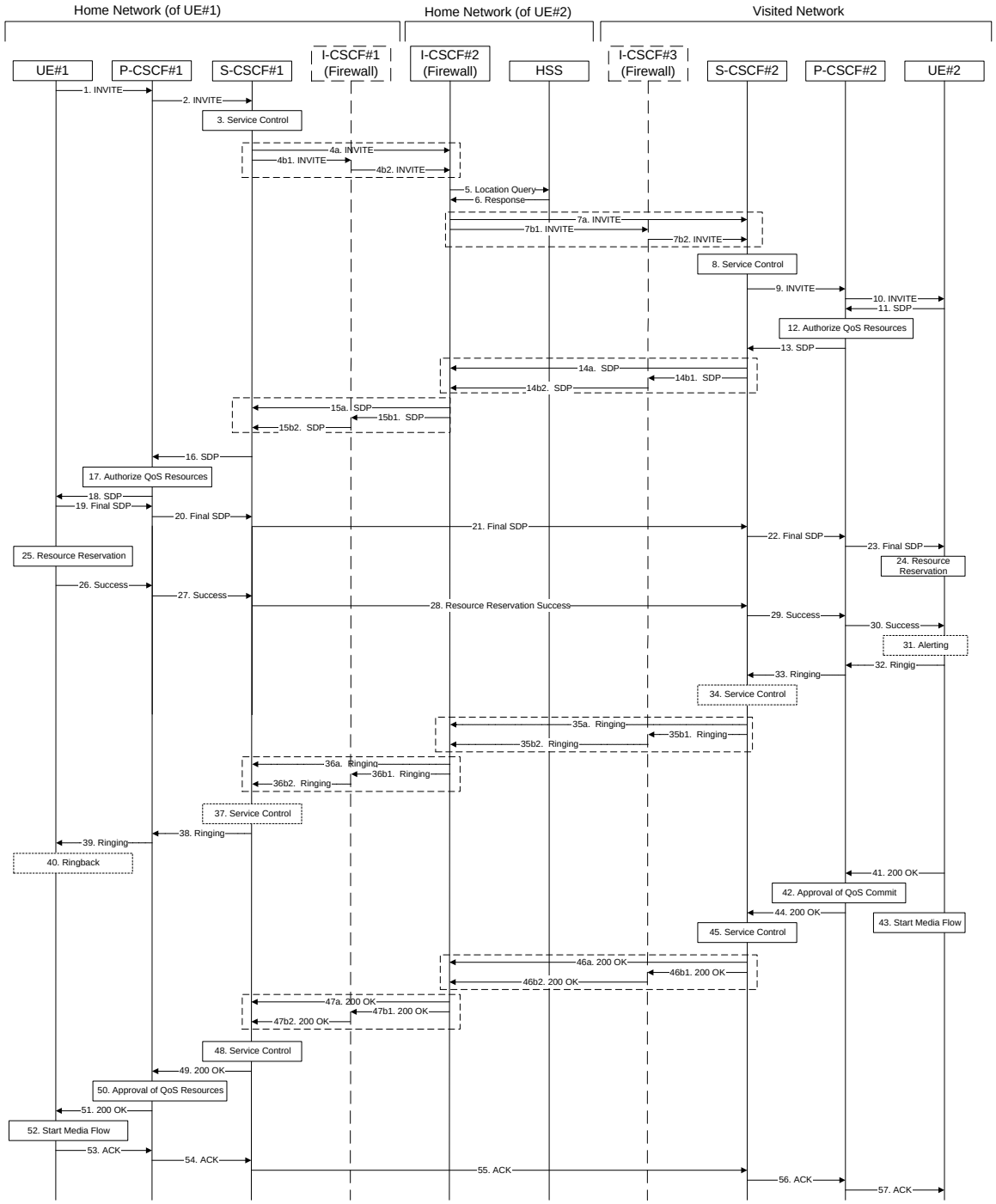
B.5 Sample end-end Call Flow - Mobile Origination Mobile Termination to a different network operator, roaming with visited control

For this end-to-end call flow, we assume the originator is a mobile station located within the service area of the network operator to whom the mobile station is subscribed. The mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. As a result of registration, an S-CSCF has been chosen in the home network.

The calling party addresses a destination that is a subscriber of a different network operator.

The called party is a mobile station located in a service area of a network operator different from that of its service subscription. This mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. During registration, the home network operator chose to let the visited network perform the call control, and an S-CSCF was chosen in the visited network.

B.5.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

1. UE#1 sends a SIP INVITE request, containing an initial SDP, to P-CSCF#1, which was obtained from the CSCF discovery procedures.

2. P-CSCF#1 forwards the INVITE to the next hop name/address, as determined from the registration procedures. In this case the next hop is S-CSCF#1 within the same operator's network.

3. S-CSCF#1 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

4. S-CSCF#1 translates the destination address and determines the call will be completed within a different operator's network. It therefore forwards the INVITE to I-CSCF#2. This is either sent direct (choice (a)), or via an I-CSCF that is performing the configuration hiding function for the home#1 network (choice (b)).

   (4a) If the home#1 network operator does not desire to keep their network configuration hidden, the INVITE request is forwarded directly to I-CSCF#2.

   (4b) If home#1 network operator desires to keep their network configuration hidden, the INVITE request is forwarded through I-CSCF#1, located within home#1 network, to I-CSCF#2.

      (4b1) S-CSCF#1 forwards the INVITE request to I-CSCF#1 within home#1 network.

      (4b2) I-CSCF#1 forwards the INVITE request to I-CSCF#2 within home#2 network.

5. I-CSCF#2 sends 'Cx-location-query' to the HSS to obtain the location information for the destination

6. The HSS responds with 'Cx-location-query-response' and indicates the destination is a roaming mobile station, under visited network control.

7. I-CSCF#2 forwards the INVITE to the S-CSCF in the visited network, possibly through an I-CSCF in the visited network. This next hop is either S-CSCF#2, which is serving the visiting UE (choice (a)), or I-CSCF#3, which is within the visited network and is performing the configuration hiding function for the visited network operator (choice (b)).

   (7a) If the visited network operator does not desire to keep their network configuration hidden, the INVITE request is forwarded directly to S-CSCF#2.

   (7b) If the visited network operator desires to keep their network configuration hidden, the INVITE request is forwarded through I-CSCF#3 to S-CSCF#2.

      (7b1) I-CSCF#2 forwards the INVITE request to I-CSCF#3 within the visited network

      (7b2) I-CSCF#3 forwards the INVITE request to S-CSCF#2

8. S-CSCF#2 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

9. S-CSCF#2 remembers (from the registration procedure) the P-CSCF#2 address, and forwards the INVITE to P-CSCF#2.

10. P-CSCF#2 remembers (from the registration procedure) the UE address, and forwards the INVITE to UE#2

11. UE#2 returns the media stream capabilities of the destination to the call originator, along the signaling path established by the INVITE message

12. P-CSCF#2 authorizes the QoS resources required for this session

13. P-CSCF#2 forwards the SDP to S-CSCF#2.

14. S-CSCF#2 forwards the SDP to I-CSCF#2. Based on the choice made in (7) above, this response may either be sent directly from S-CSCF#2 to I-CSCF#2 (choice (a)), or be sent indirectly through I-CSCF#3 (firewall) (choice (b)).

15. I-CSCF#2 forwards the SDP to S-CSCF#1. Based on the choice made in (4) above, this response may either be sent directly from I-CSCF#2 to S-CSCF#1 (choice (a)), or be sent indirectly through I-CSCF#1 (firewall) (choice (b)).

16. S-CSCF#1 forwards the SDP message to P-CSCF#1

17. P-CSCF#1 authorizes the resources necessary for this session
18. P-CSCF#1 forwards the SDP message to the originating endpoint, UE#1
19. The originator decides the final set of media streams for this session, and sends the Final SDP to P-CSCF#1
20. P-CSCF#1 forwards the final SDP to S-CSCF#1
21. S-CSCF#1 forwards the final SDP to S-CSCF#2. This message may be routed through I-CSCF#1 and/or I-CSCF#2 and/or I-CSCF#3, depending on operator configuration of I-CSCF#1, I-CSCF#2, and I-CSCF#3.
22. S-CSCF#2 forwards the final SDP to P-CSCF#2.
23. P-CSCF#2 forwards the final SDP to UE#2.
24. UE#2 initiates the resource reservation procedures for the resources necessary for this session.
25. After determining the final set of media streams for this session, step #19 above, UE#1 initiates the reservation procedures for the resources needed for this session
26. When UE#1 has successfully reserved the needed resources, it sends the “reservation successful” message to UE#2 along the signaling path established by the INVITE message. The message is sent first to P-CSCF#1.
27. P-CSCF#1 forwards the message to S-CSCF#1
28. S-CSCF#1 forwards the message to S-CSCF#2. This message may be routed through I-CSCF#1 and/or I-CSCF#2 and/or I-CSCF#3, depending on operator configuration of I-CSCF#1, I-CSCF#2, and I-CSCF#3.
29. S-CSCF#2 forwards the message to P-CSCF#2.
30. P-CSCF#2 forwards the message to UE#2.
31. UE#2 may optionally delay the session establishment in order to alert the subscriber to the incoming call.
32. If UE#2 performs alerting, it sends a ringing indication to the originator via the signaling path. The message is sent first to P-CSCF#2.
33. P-CSCF#2 forwards the ringing message to S-CSCF#2.
34. S-CSCF#2 performs whatever service control is appropriate for this ringing call
35. S-CSCF#2 forwards the message to I-CSCF#2. Based on the choice made in (7) above, this response may either be sent directly from S-CSCF#2 to I-CSCF#2 (choice (a)), or be sent indirectly through I-CSCF#3 (firewall) (choice (b)).
36. I-CSCF#2 forwards the message to S-CSCF#1. Based on the choice made in (4) above, this response may either be sent directly from I-CSCF#2 to S-CSCF#1 (choice (a)), or be sent indirectly through I-CSCF#1 (firewall) (choice (b)).
37. S-CSCF#1 performs whatever service control is appropriate for this ringing call.
38. S-CSCF#1 forwards the message to P-CSCF#1
39. P-CSCF#1 forwards the message to UE#1
40. UE#1 indicates to the originator that the session is being delayed due to alerting. Typically this involves playing a ringback sequence.
41. When the called party answers, UE#2 sends a SIP 200-OK final response to P-CSCF#2
42. P-CSCF#2 approves the commitment of the QoS resources for this session.
43. After sending the 200-OK, UE#2 initiates the media flow
44. P-CSCF#2 sends the SIP 200-OK final response along the signaling path to S-CSCF#2.
45. S-CSCF#2 performs whatever service control is appropriate for the completed call.

46. S-CSCF#2 sends a SIP 200-OK final response along the signaling path back to I-CSCF#2. Based on the choice made in (7) above, this response is either sent directly from S-CSCF#2 to I-CSCF#2 (choice (a)), or is sent indirectly through I-CSCF#3 firewall (choice (b)).

47. I-CSCF#2 sends the SIP 200-OK final response along the signaling path to S-CSCF#1. Based on the choice made in (4) above, this response is either sent directly from I-CSCF#2 to S-CSCF#1 (choice (a)), or is sent indirectly through I-CSCF#1 firewall (choice (b)).

48. S-CSCF#1 performs whatever service control is appropriate for the completed call.

49. S-CSCF#1 sends a SIP 200-OK final response along the signaling path back to P-CSCF#1.

50. P-CSCF#1 approves the commitment of the QoS resources for this session.

51. P-CSCF#1 sends a SIP 200-OK final response along the signaling path back to UE#1

52. UE#1 starts the media flow for this session.

53. UE#1 responds to the final response with a SIP ACK message, which is passed to UE#2 via the signaling path. The message is sent first to P-CSCF#1.

54. P-CSCF#1 forwards the ACK to S-CSCF#1

55. S-CSCF#1 forwards the ACK to S-CSCF#2. This message may be routed through I-CSCF#1 and/or I-CSCF#2 and/or I-CSCF#3, depending on operator configuration of I-CSCF#1, I-CSCF#2, and I-CSCF#3.

56. S-CSCF#2 forwards the ACK to P-CSCF#2

57. P-CSCF#2 forwards the ACK to UE#2.

B.5.2 Call Flow Decomposition into Procedure Blocks

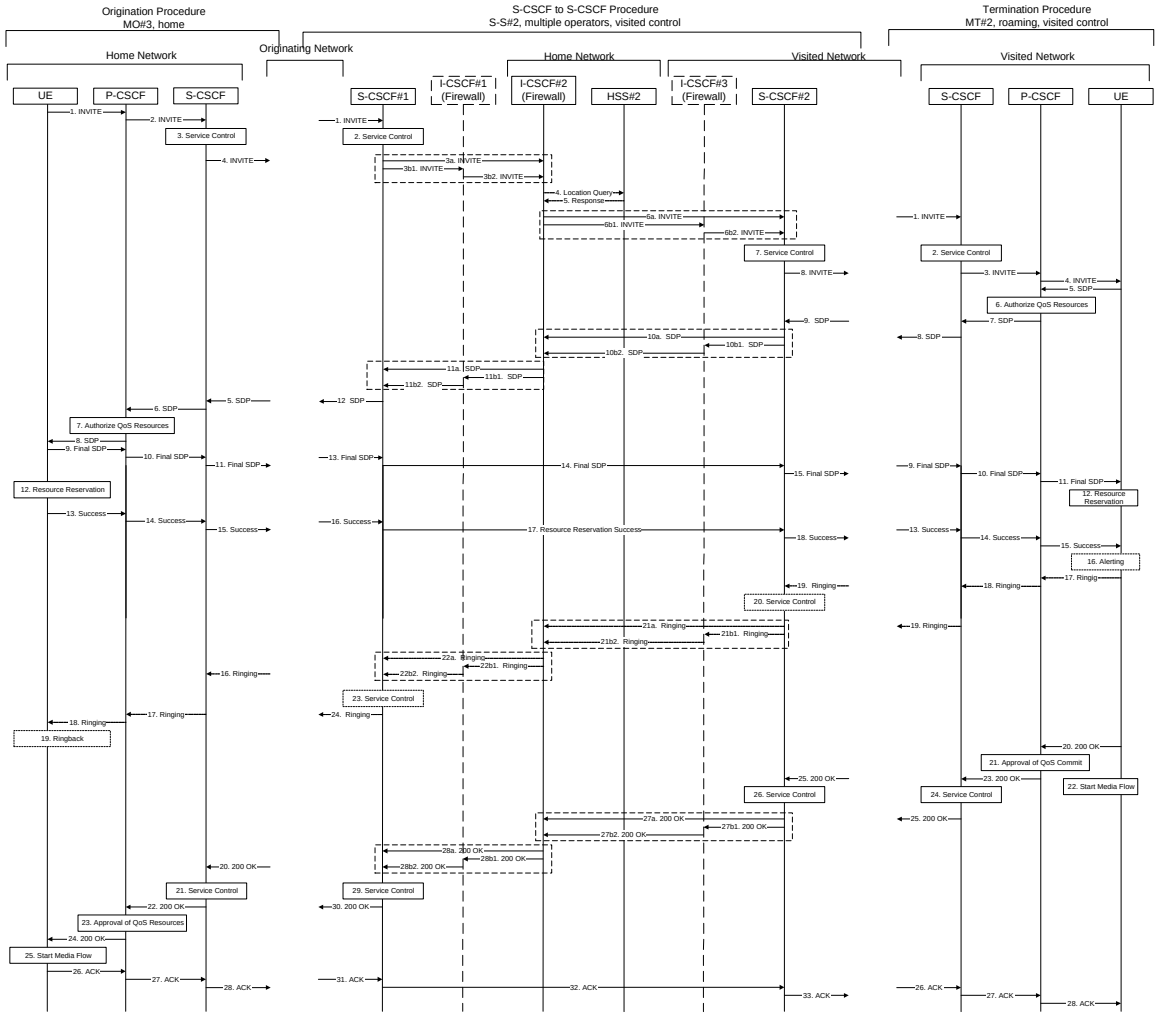
The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.3, *(MO#3) Mobile origination, located in home network.*

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.2, *(S-S#2) Different network operators performing origination and termination, visited network control of termination*.

The terminating part is for a mobile termination, roaming, with visited control. This procedure is given in Section 5.8.2, *(MT#2) Mobile termination, roaming, with visited network control of services.*

The following diagram illustrates this decomposition, showing how the three separate procedures fit together to produce an end-to-end call flow.



B.5.3 Issues

None identified

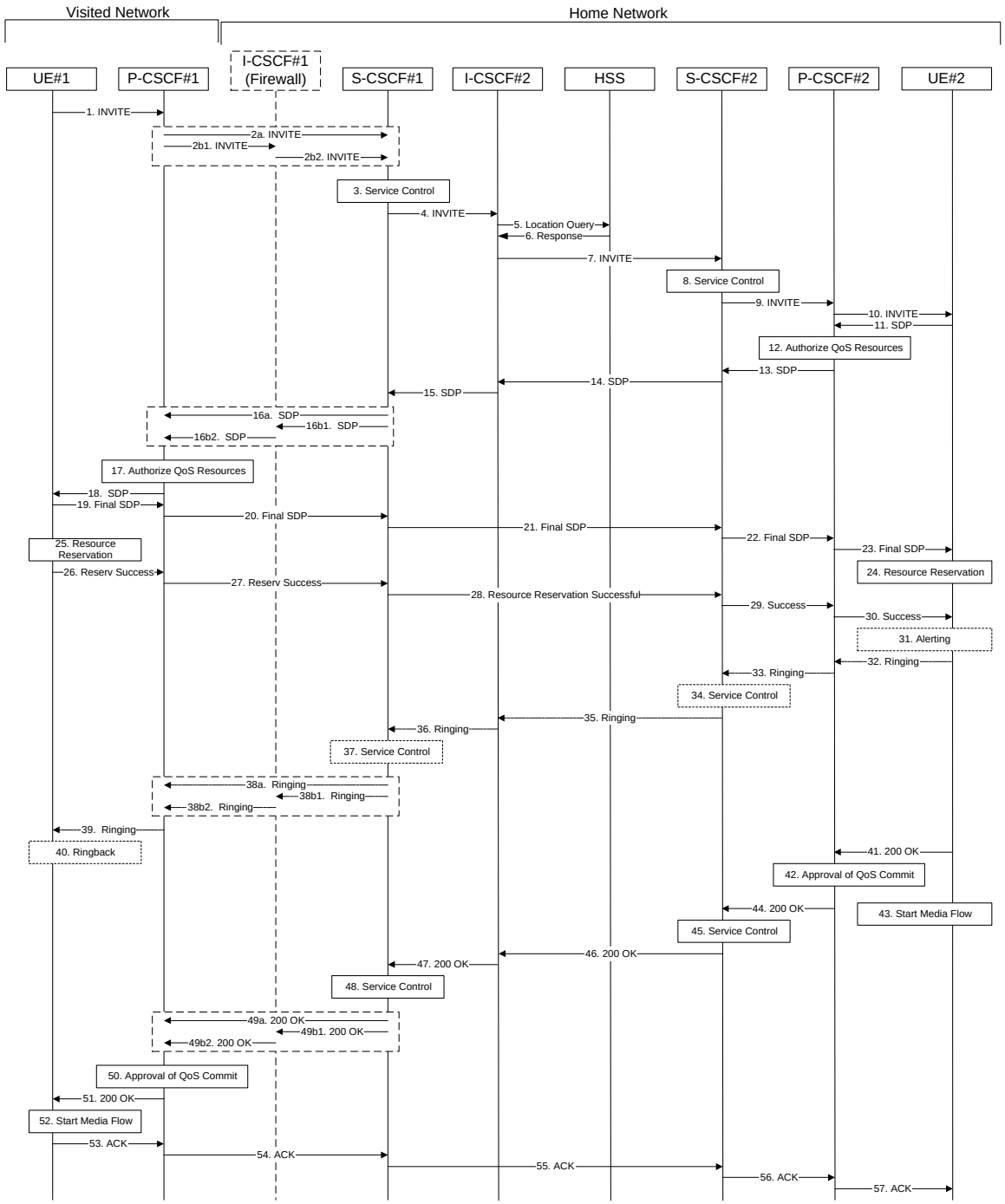
B.6 Sample end-end Call Flow - Mobile Origination, roaming with home control, to Mobile Termination, home

For this end-to-end call flow, we assume the originator is a mobile station located outside the service area of the network operator to whom the mobile station is subscribed. The mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. During registration the home network operator chose to exercise home control, and an S-CSCF has been chosen in the home network.

The calling party addresses a destination that is a subscriber of the same network operator.

The called party is a mobile station located within the service area of the network operator to which it is subscribed. This mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. As a result of registration, an S-CSCF was chosen in the home network.

B.6.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

1. UE#1 sends a SIP INVITE request, containing an initial SDP, to P-CSCF#1, which was obtained from the CSCF discovery procedures.

2. P-CSCF#1 remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE to the S-CSCF within the home operator's network, possibly through an I-CSCF. The next hop is either S-CSCF#1 serving UE#1 (choice (a)), or I-CSCF#1 in the home network that is performing the configuration hiding function for the home network operator (choice (b)).

   (2a) If the home network operator does not desire to keep their network configuration hidden, the INVITE request is forwarded directly to S-CSCF#1

   (2b) If the home network operator desires to keep their network configuration hidden, the INVITE request is forwarded through an I-CSCF to the S-CSCF

      (2b1) P-CSCF#1 forwards the INVITE request to I-CSCF#1 in the home network

(2b2) I-CSCF#1 forwards the INVITE request to S-CSCF#1.

3. S-CSCF#1 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.
4. S-CSCF#1 translates the destination address and determines the call will be completed within the home operator's network. It therefore forwards the INVITE to I-CSCF#2.
5. I-CSCF#2 sends 'Cx-location-query' to the HSS to obtain the location information for the destination
6. The HSS responds with 'Cx-location-query-response' and indicates the destination is in the home service area.
7. I-CSCF#2 forwards the INVITE to S-CSCF#2, identified by the HSS as serving this subscriber.
8. S-CSCF#2 validates the service profile, and performs whatever service control logic is appropriate for this call attempt.
9. S-CSCF#2 remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE to P-CSCF#2 in the home network.
10. P-CSCF#2 remembers (from the registration procedure) the UE address, and forwards the INVITE to the UE
11. UE#2 returns the media stream capabilities of the destination to the call originator, along the signaling path established by the INVITE message
12. P-CSCF#2 authorizes the QoS resources required for this session
13. P-CSCF#2 forwards the SDP to S-CSCF#2.
14. S-CSCF#2 forwards the SDP to I-CSCF#2.
15. I-CSCF#2 forwards the SDP to S-CSCF#1
16. S-CSCF#1 forwards the SDP message to P-CSCF#1. Based on the choice made in (2) above, this response may either be sent directly from S-CSCF#1 to P-CSCF#1 (choice (a)), of be sent indirectly through I-CSCF#1 Firewall (choice (b)).
17. P-CSCF#1 authorizes the resources necessary for this session
18. P-CSCF#1 forwards the SDP message to the originating endpoint, UE#1
19. The originator decides the final set of media streams for this session, and sends the Final SDP to P-CSCF#1
20. P-CSCF#1 forwards the final SDP to S-CSCF#1. This message may be routed through I-CSCF#1, depending on operator configuration of I-CSCF#1.
21. S-CSCF#1 forwards the final SDP to S-CSCF#2. This message may be routed through I-CSCF#2, depending on operator configuration of I-CSCF#2.
22. S-CSCF#2 forwards the final SDP to P-CSCF#2.
23. P-CSCF#2 forwards the final SDP to UE#2.
24. UE#2 initiates the resource reservation procedures for the resources necessary for this session.
25. After determining the final set of media streams for this session, step #19 above, UE#1 initiates the reservation procedures for the resources needed for this session
26. When UE#1 has successfully reserved the needed resources, it sends the "reservation successful" message to UE#2 along the signaling path established by the INVITE message. The message is sent first to P-CSCF#1.
27. P-CSCF#1 forwards the message to S-CSCF#1. This message may be routed through I-CSCF#1, depending on operator configuration of I-CSCF#1.
28. S-CSCF#1 forwards the message to S-CSCF#2. This message may be routed through I-CSCF#2, depending on operator configuration of I-CSCF#2.
29. S-CSCF#2 forwards the message to P-CSCF#2.

30. P-CSCF#2 forwards the message to UE#2.
31. UE#2 may optionally delay the session establishment in order to alert the subscriber to the incoming call.
32. If UE#2 performs alerting, it sends a ringing indication to the originator via the signaling path. The message is sent first to P-CSCF#2.
33. P-CSCF#2 forwards the ringing message to S-CSCF#2.
34. S-CSCF#2 performs whatever service control is appropriate for this ringing call
35. S-CSCF#2 forwards the message to I-CSCF#2
36. I-CSCF#2 forwards the message to S-CSCF#1
37. S-CSCF#1 performs whatever service control is appropriate for this ringing call.
38. S-CSCF#1 forwards the message to P-CSCF#1. Based on the choice made in (2) above, this response may either be sent directly from S-CSCF#1 to P-CSCF#1 (choice (a)), of be sent indirectly through I-CSCF#1 Firewall (choice (b)).
39. P-CSCF#1 forwards the message to UE#1
40. UE#1 indicates to the originator that the session is being delayed due to alerting. Typically this involves playing a ringback sequence.
41. When the called party answers, the UE sends a SIP 200-OK final response to P-CSCF#2
42. P-CSCF#2 approves the commitment of the QoS resources for this session
43. After sending the 200-OK, US#2 initiates the media flow.
44. P-CSCF#2 sends a SIP 200-OK final response along the signaling path back to S-CSCF#2.
45. S-CSCF#2 performs whatever service control is appropriate for the completed call.
46. S-CSCF#2 sends a SIP 200-OK final response along the signaling path back to I-CSCF#2.
47. I-CSCF#2 sends a SIP 200-OK final response along the signaling path back to S-CSCF#1. Based on the choice made in (2) above, this response may either be sent directly from I-CSCF#2 to S-CSCF#1 (choice (a)), of be sent indirectly through I-CSCF#1 Firewall (choice (b)).
48. S-CSCF#1 performs whatever service control logic is appropriate for this call completion
49. S-CSCF#1 sends a SIP 200-OK final response along the signaling path back to P-CSCF#1
50. P-CSCF#1 approves the commitment of the QoS resources for this session.
51. P-CSCF#1 sends a SIP 200-OK final response along the signaling path back to UE#1
52. UE#1 starts the media flow for this session
53. UE#1 responds to the final response with a SIP ACK message, which is passed to UE#2 via the signaling path. This message is sent first to P-CSCF#1.
54. P-CSCF#1 forwards the ACK to S-CSCF#1. This message may be routed through I-CSCF#1, depending on operator configuration of I-CSCF#1.
55. S-CSCF#1 forwards the ACK to S-CSCF#2. This message may be routed through I-CSCF#2, depending on operator configuration of I-CSCF#2.
56. S-CSCF#2 forwards the ACK to P-CSCF#2.
57. P-CSCF#2 forwards the ACK to UE#2.

B.6.2 Call Flow Decomposition into Procedure Blocks

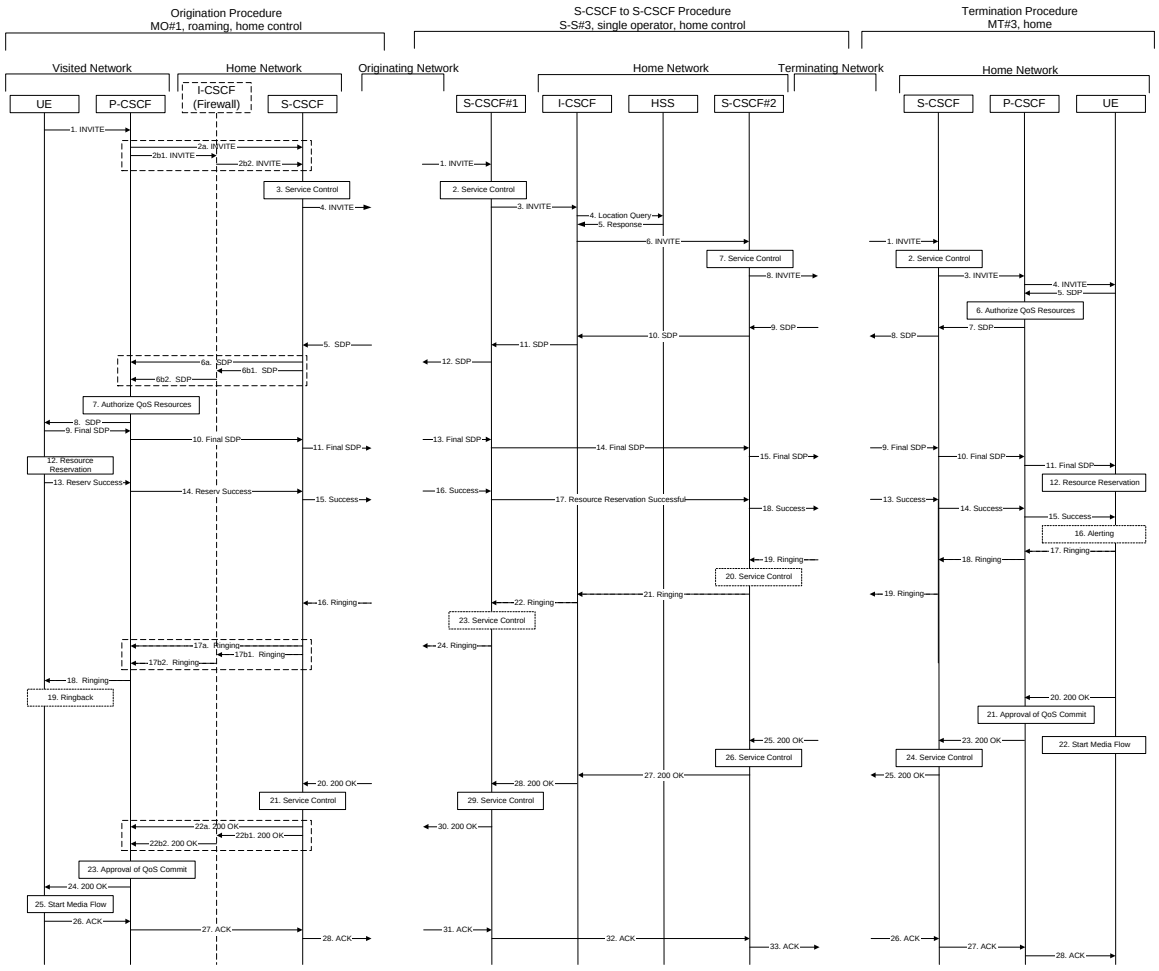
The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.1, *(MO#1) Mobile origination, roaming, with home control of services*.

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.3, *(S-S#3) Single network operator performing origination and termination, with home control of termination*.

The terminating part is for a mobile termination, with the subscriber located in the home operator service area. This procedure is given in Section 5.8.3, *(MT#3) Mobile termination, located in home network.*

The following diagram illustrates this decomposition, showing how the three separate procedures fit together to produce an end-to-end call flow.



B.6.3 Issues

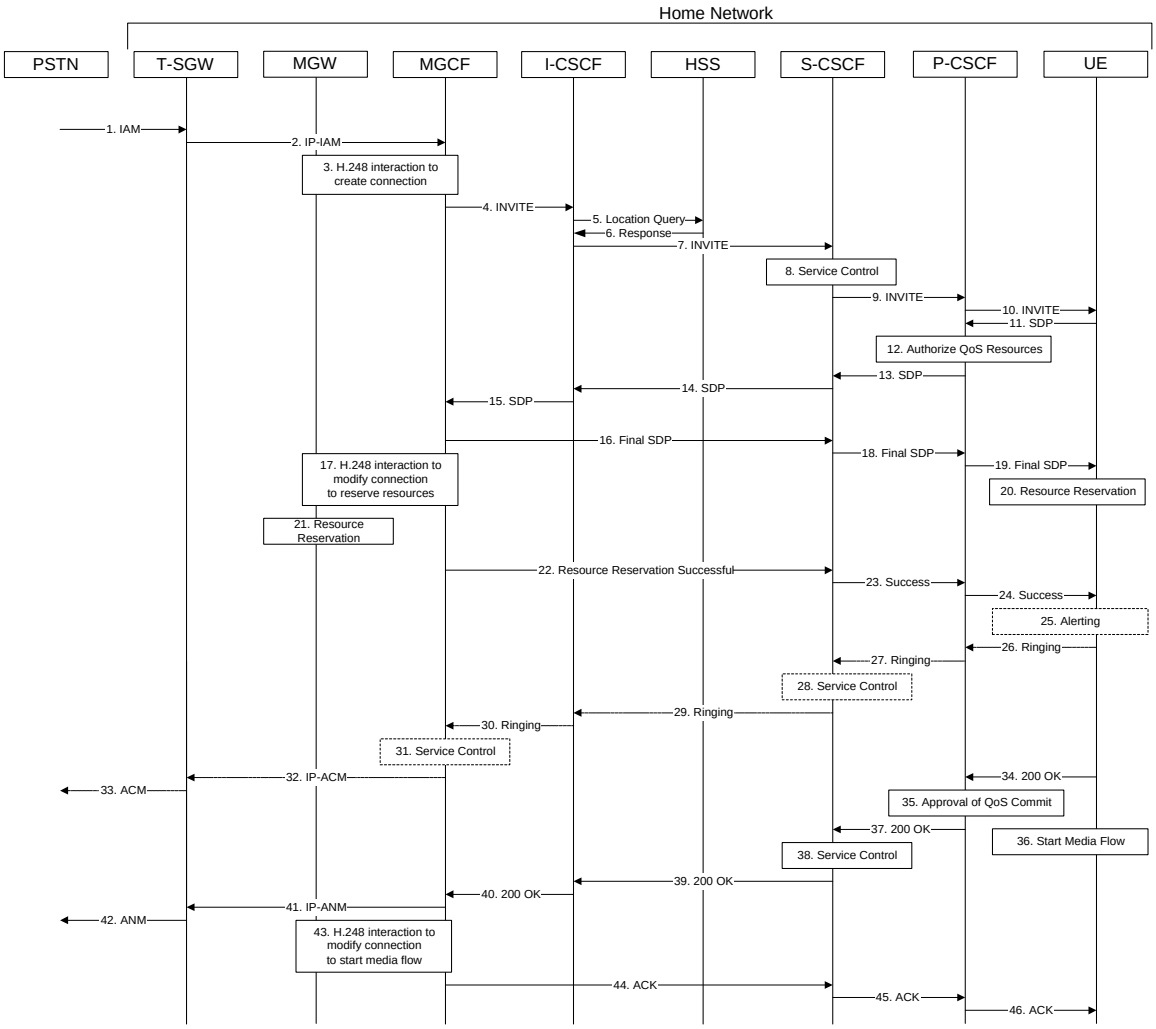
The mechanism by which the P-CSCF identifies the I-CSCF and the mechanism by which the I-CSCF identifies the S-CSCF is FFS.

B.7 Sample end-end Call Flow - PSTN Origination Mobile Termination

The calling party on the PSTN addresses a destination that is a subscriber of the 3G network operator.

The called party is a mobile station located within the service area of the network operator to which it is subscribed. This mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. As a result of registration, an S-CSCF was chosen in the home network.

B.7.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

1. The PSTN establishes a bearer path to the MGW, and signals to the T-SGW with a SS7 IAM message, giving the trunk identity and destination information

2. The T-SGW forwards the SS7 message, encapsulated in IP, to the MGCF.

3. The MGCF initiates a H.248 command to seize the trunk and an IP port.

4. The MGCF translates the destination address and determines the call will be completed within the home network. MGCF initiates a SIP INVITE request, containing an initial SDP, to I-CSCF.

5. I-CSCF sends 'Cx-location-query' to the HSS to obtain the location information for the destination

6. The HSS responds with 'Cx-location-query-response' and indicates the destination is in the home service area.

7. I-CSCF forwards the INVITE to S-CSCF, identified by the HSS as serving this subscriber.

8. S-CSCF validates the service profile, and performs whatever service control logic is appropriate for this call attempt.
9. S-CSCF remembers (from the registration procedure) the address of P-CSCF, and forwards the INVITE to P-CSCF.
10. P-CSCF remembers (from the registration procedure) the address of UE, and forwards the INVITE to UE.
11. UE#2 returns the media stream capabilities of the destination to the call originator, along the signaling path established by the INVITE message
12. P-CSCF authorizes the QoS resources required for this session
13. P-CSCF forwards the SDP to S-CSCF.
14. S-CSCF forwards the SDP to I-CSCF
15. I-CSCF forwards the SDP to MGCF
16. MGCF decides the final set of media streams for this session, and sends the Final SDP to S-CSCF. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.
17. MGCF initiates a H.248 command to modify the connection parameters and instruct the MGW to reserve the resources needed for the session
18. S-CSCF forwards the final SDP to P-CSCF.
19. P-CSCF forwards the final SDP to UE.
20. UE initiates the resource reservation procedures for the resources necessary for this session.
21. MGW reserves the resources needed for the session
22. When MGW has successfully reserved the needed resources, MGCF sends the “reservation successful” message to UE along the signaling path established by the INVITE message. The message is sent to S-CSCF, and may be routed through I-CSCF, depending on operator configuration of I-CSCF.
23. S-CSCF forwards the message to P-CSCF.
24. P-CSCF forwards the message to UE.
25. UE may optionally delay the session establishment in order to alert the subscriber to the incoming call.
26. If UE performs alerting, it sends a ringing indication to the originator via the signaling path. The message is sent first to P-CSCF.
27. P-CSCF forwards the ringing message to S-CSCF.
28. S-CSCF performs whatever service control is appropriate for this ringing call
29. S-CSCF forwards the message to I-CSCF
30. I-CSCF forwards the message to MGCF
31. MGCF performs whatever service control is appropriate for this ringing call.
32. If alerting is being performed, the MGCF forwards an IP-ACM message to T-SGW
33. If alerting is being performed, the T-SGW forwards a SS7 ACM message
34. When the called party answers, the UE sends a SIP 200-OK final response to P-CSCF
35. P-CSCF approves the commitment of the QoS resources for this session.
36. After sending the 200-OK, UE initiates the media flow.
37. P-CSCF sends the SIP 200-OK final response to S-CSCF

38. S-CSCF performs whatever service control logic is appropriate for this call completion
39. S-CSCF sends the SIP 200-OK final response to I-CSCF
40. I-CSCF sends the SIP 200-OK final response to MGCF
41. MGCF forwards an IP-ANM message to T-SGW
42. T-SGW forwards an ANM message to the PSTN
43. MGCF alters the connection at MGW, via a H.248 command, to make it bi-directional
44. MGCF acknowledges the SIP final response with a SIP ACK message, which is passed to UE#2 via the signaling path. This message is sent to S-CSCF, and may be routed through I-CSCF, depending on operator configuration of I-CSCF.
45. S-CSCF forwards the ACK to P-CSCF
46. P-CSCF forwards the ACK to UE

B.7.2 Call Flow Decomposition into Procedure Blocks

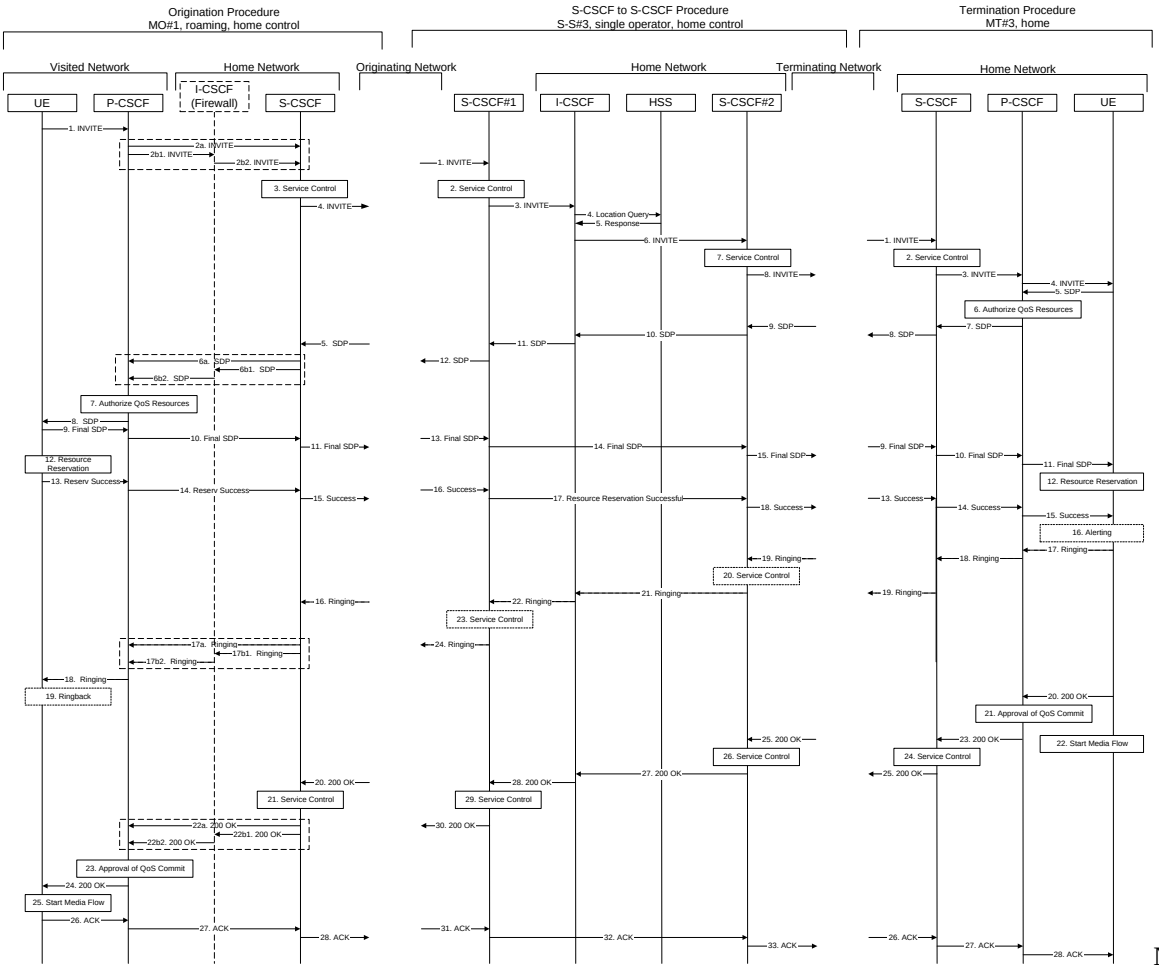
The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.4, *(PSTN-O) PSTN origination*.

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.3, *(S-S#3) Single network operator performing origination and termination, with home control of termination*.

The terminating part is for a mobile termination, with the subscriber located in the home operator service area. This procedure is given in Section 5.8.3, *(MT#3) Mobile termination, located in home network.*

The following diagram illustrates this decomposition, showing how the three separate procedures fit together to produce an end-to-end call flow.



Note: the S-CSCF#1 in the S-S#3 procedure is the MGCF of the PSTN-O procedure.

B.7.3 Issues

None identified.

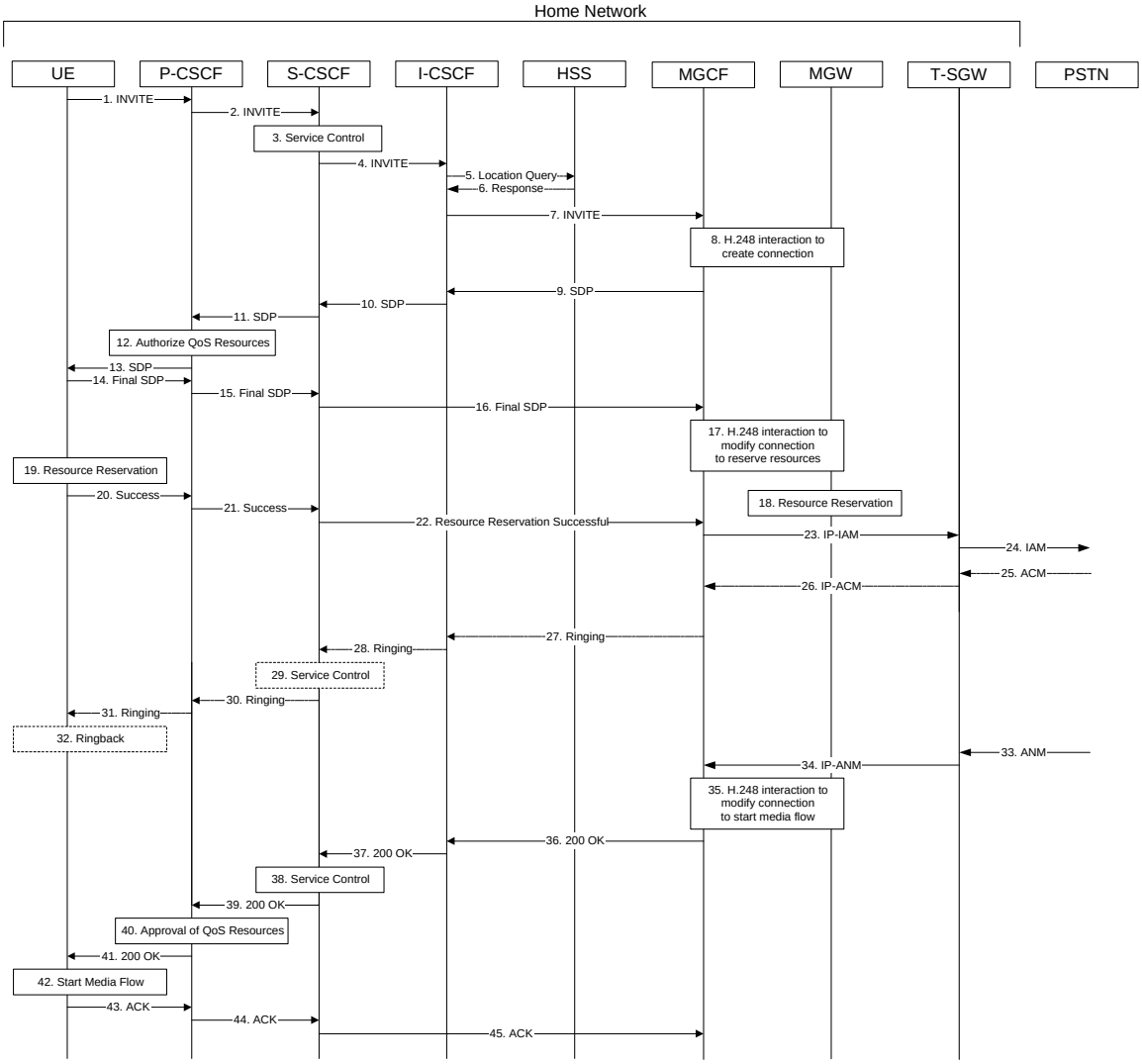
B.8 Sample end-end Call Flow - Mobile Origination, PSTN Termination in same network

For this end-to-end call flow, we assume the originator is a mobile station located within the service area of the network operator to whom the mobile station is subscribed. The calling party has already established the proper PDP contexts for exchange of SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. As a result of registering, an S-CSCF has been chosen in the home network.

The UE originating the call addresses a destination that is a non-3GPP endpoint. Therefore, the call must be completed through a Media Gateway.

The network operator serving this subscriber either decides to use a local PSTN gateway, or does not have agreements with other network operators for optimal gateway selection.

B.8.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

1. The UE sends a SIP INVITE request, containing an initial SDP, to the P-CSCF, which was obtained from the CSCF discovery procedures.

2. The P-CSCF forwards the INVITE to the next hop name/address, as determined from the registration procedures. In this case the next hop is the S-CSCF within the same operator's network.

3. The S-CSCF validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

4. The S-CSCF translates the destination address and determines the call will be completed within the home operator's network. It therefore forwards the INVITE to an I-CSCF.

5. If the I-CSCF cannot determine, based on analysis of the destination number, that the HSS query will fail, then the I-CSCF will send 'Cx-location-query' to the HSS to obtain the location information for the destination. If the I-CSCF can determine, based on analysis of the destination number, that the HSS query will fail, it will not send the 'Cs-location-query' message, and continue with step #7.

6. The HSS responds with 'Cx-location-query-response' and indicates the destination is not currently registered in the 3G IM subsystem, and therefore the call should be completed via the PSTN.

7. The I-CSCF decides to use an MGW in the home network, allocates a MGCF, and sends the INVITE request to the MGCF

8. MGCF initiates a H.248 interaction to pick an outgoing channel and determine media capabilities of the MGW.

9. MGCF determines the subset of the media flows proposed by the originating endpoint that it supports, and responds with an SDP message back to the originator via the signaling path. This response is sent to I-CSCF.

10. I-CSCF forwards the SDP to S-CSCF

11. S-CSCF forwards the SDP message to P-CSCF

12. P-CSCF authorizes the resources necessary for this session

13. P-CSCF forwards the SDP message to the originating endpoint, UE.

14. The originator decides the final set of media streams for this session, and sends the Final SDP to P-CSCF.

15. P-CSCF forwards the final SDP to S-CSCF

16. S-CSCF forwards the final SDP to MGCF. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.

17. MGCF initiates a H.248 interaction to modify the connection established in step #8 and instruct MGW to reserve the resources necessary for the media stream.

18. MGW reserves the resources necessary for the media stream.

19. After determining the final set of media streams for this session, step #14 above, UE initiates the reservation procedures for the resources needed for this session.

20. When UE has successfully reserved the needed resources, it sends the “reservation successful” message to MGCF along the signaling path established by the INVITE message. This message is send first to P-CSCF.

21. P-CSCF forwards the message to S-CSCF.

22. S-CSCF forwards the message to MGCF. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.

23. MGCF sends an IP-IAM message to the T-SGW

24. T-SGW receives the IP-IAM and sends the SS7 IAM message into the PSTN.

25. When the PSTN has established the path to the destination, it may optionally alert the destination user before completing the call. If so, it responds with an SS7 ACM message

26. T-SGW sends an IP-ACM message to MGCF

27. If the PSTN is alerting the destination user, MGCF indicates this to the calling party by a provisional response indicating Ringing. This message is sent to I-CSCF.

28. I-CSCF forwards the message to S-CSCF

29. S-CSCF performs whatever service control is appropriate for this ringing call.

30. S-CSCF forwards the message to P-CSCF

> Editor’s Note: Additional QoS interactions to handle one-way media at this point (e.g. for PSTN ringback and announcements) is for further study.

31. P-CSCF forwards the message to UE

32. UE indicates to the originator that the session is being delayed due to alerting. Typically this involves playing a ringback sequence.

33. When the called party answers, the PSTN sends an SS7 ANM message to T-SGW

34. T-SGW sends an IP-ANM message to MGCF

35. MGCF initiates a H.248 interaction to make the connection in the MGW bi-directional

36. MGCF sends a SIP 200-OK final response along the signaling path back to the call originator

37. I-CSCF sends a SIP 200-OK final response along the signaling path back to the call originator

38. S-CSCF performs whatever service control logic is appropriate for this call completion

39. S-CSCF sends a SIP 200-OK final response to P-CSCF

40. P-CSCF approves the commitment of the QoS resources for this session

41. P-CSCF sends a SIP 200-OK final response along the signaling path back to the call originator

42. UE starts the media flow for this session

43. UE responds to the final response with a SIP ACK message, which is passed to the MGCF via the signaling path. The message is sent first to P-CSCF

44. P-CSCF forwards the ACK to S-CSCF.

45. S-CSCF forwards the ACK to MGCF. This message may be routed through I-CSCF, depending on operator configuration of I-CSCF.

B.8.2 Call Flow Decomposition into Procedure Blocks

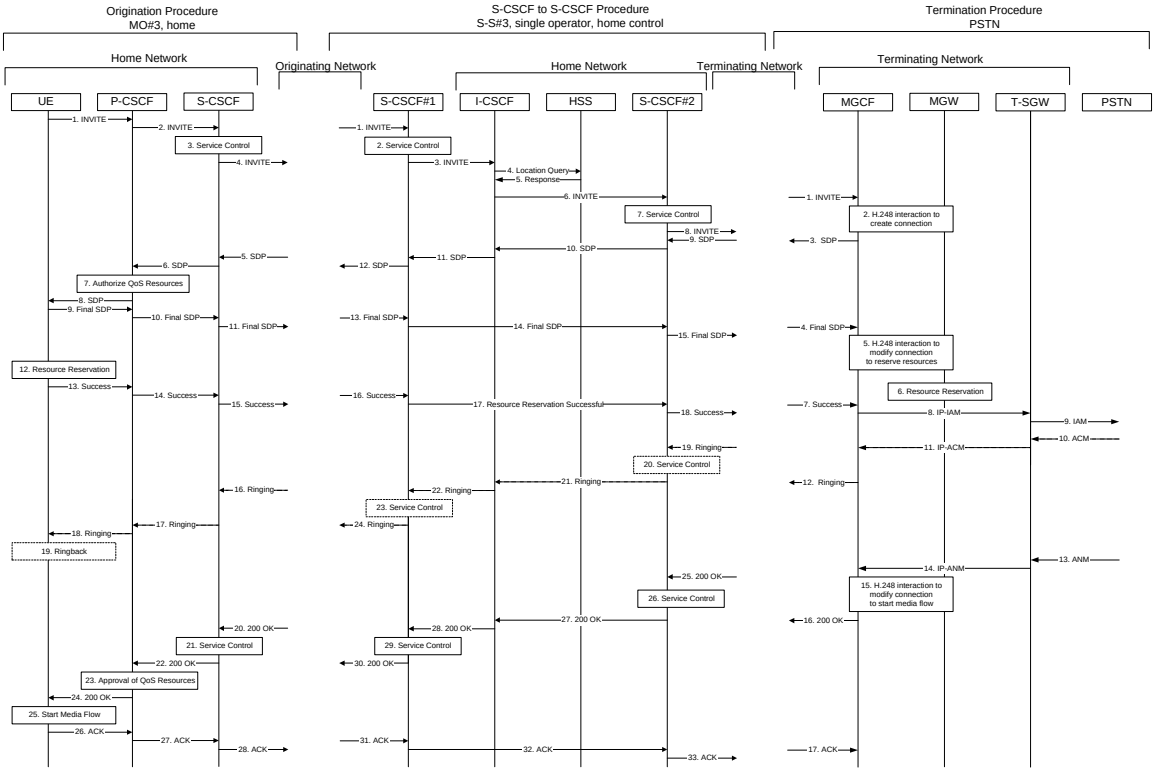
The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.3, *(MO#3) Mobile origination, located in home network.*

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.3, *(S-S#3) Single network operator performing origination and termination, with home control of termination*.

The terminating part is for PSTN termination. This procedure is given in Section 5.8.4, *(PSTN-T) PSTN Termination*.

The following diagram illustrates this decomposition, showing how the three separate procedures fit together to produce an end-to-end call flow.



Note: the S-CSCF#2 in the S-S#3 procedure is the MGCF of the PSTN-T procedure.

B.8.3 Issues

More study is required in how the I-CSCF selects the MGCF.

B.9 Sample end-end Call Flow - Mobile Origination, roaming with visited control, PSTN Termination by home network

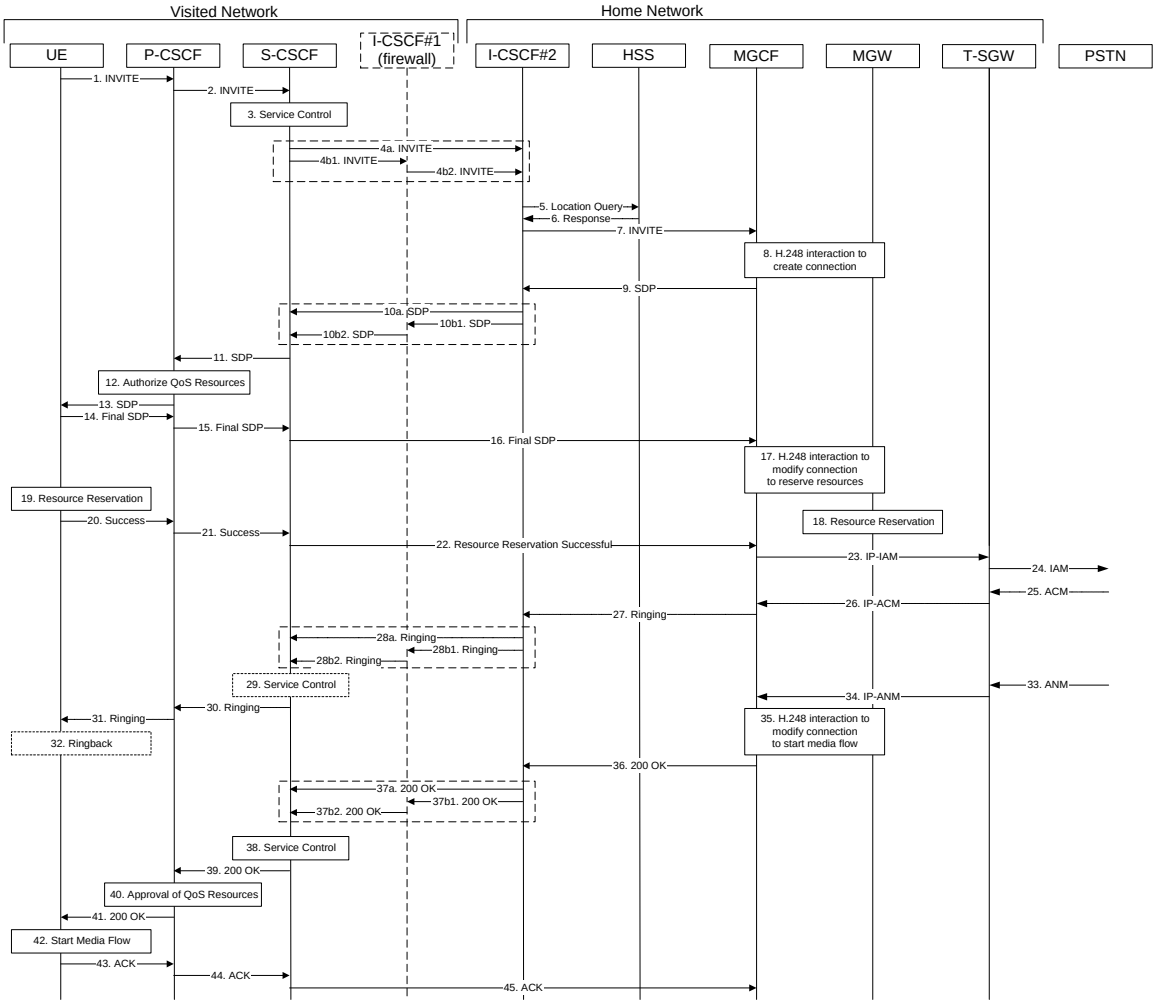
For this end-to-end call flow, we assume the originator is a mobile station located outside the service area of the network operator to whom the mobile station is subscribed. The mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. During registration the home network operator chose to accept the offer of visited control, and an S-CSCF has been chosen in the visited network.

The UE originating the call addresses a destination that is not a 3GPP endpoint, i.e. an E.164 number that must be completed by the PSTN.

The visited network operator decides not to perform the PSTN gateway function for this call attempt, rather to pass it to the subscriber's home network for call completion.

The home network operator of this subscriber either decides to use a local PSTN gateway, or does not have agreements with other network operators for optimal gateway selection.

B.9.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

1. The UE sends a SIP INVITE request, containing an initial SDP, to the P-CSCF, which was obtained from the CSCF discovery procedures.

2. The P-CSCF forwards the INVITE to the next hop name/address, as determined from the registration procedures. In this case the next hop is the S-CSCF within the visited operator's network.

3. The S-CSCF validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

4. The S-CSCF translates the destination address, and determines it is not a 3G endpoint. It decides to pass the call to the subscriber's home network operator for completion rather than completing the call locally. It therefore forwards the INVITE to the subscriber's home network operator's I-CSCF. The next hop is either I-CSCF#2 in UE#1's home network (choice (a)), or I-CSCF#1 in the visited network that is performing the configuration hiding function for the visited network operator (choice (b)). The S-CSCF performs number treatment so it has a meaning in the terminating network.

   (4a) If the visited network operator does not desire to keep their network configuration hidden, the INVITE request is forwarded directly to I-CSCF#2

   (4b) If the visited network operator desires to keep their network configuration hidden, the INVITE request is forwarded through I-CSCF#1 to I-CSCF#2

      (4b1) S-CSCF forwards the INVITE request to I-CSCF#1 in the visited network

      (4b2) I-CSCF#1 forwards the INVITE request to I-CSCF#2.

5. If I-CSCF#2 cannot determine, based on analysis of the destination number, that the HSS query will fail, then it will send 'Cx-location-query' to the HSS to obtain the location information for the destination. If I-CSCF#2 can determine, based on analysis of the destination number, that the HSS query will fail, it will not send the 'Cx-location-query' message, and continue with step #7

6. The HSS responds with 'Cx-location-query-response' and indicates the destination is not a mobile station, and therefore the call should be completed via the PSTN.

7. The I-CSCF decides to use an MGW in the home network, allocates a MGCF, and sends the INVITE request to the MGCF

8. MGCF initiates a H.248 interaction to pick an outgoing channel and determine media capabilities of the MGW.

9. MGCF determines the subset of the media flows proposed by the originating endpoint that it supports, and responds with an SDP message back to the originator via the signaling path. This response is sent to I-CSCF#2.

10. I-CSCF#2 forwards the SDP to S-CSCF. Based on the decision made in step #4 above, this message may be sent directly from I-CSCF#2 to S-CSCF (choice (a)), or may be routed through I-CSCF#1 (choice (b)).

11. S-CSCF forwards the SDP message to P-CSCF

12. P-CSCF authorizes the resources necessary for this session

13. P-CSCF forwards the SDP message to the originating endpoint, UE.

14. The originator decides the final set of media streams for this session, and sends the Final SDP to P-CSCF.

15. P-CSCF forwards the final SDP to S-CSCF

16. S-CSCF forwards the final SDP to MGCF. This message may be routed through I-CSCF#1 and/or I-CSCF#2, depending on operator configuration of I-CSCF#1 and I-CSCF#2.

17. MGCF initiates a H.248 interaction to modify the connection established in step #8 and instruct MGW to reserve the resources necessary for the media stream.

18. MGW reserves the resources necessary for the media stream.

19. After determining the final set of media streams for this session, step #14 above, UE initiates the reservation procedures for the resources needed for this session.

20. When UE has successfully reserved the needed resources, it sends the "reservation successful" message to MGCF along the signaling path established by the INVITE message. This message is send first to P-CSCF.

21. P-CSCF forwards the message to S-CSCF.

22. S-CSCF forwards the message to MGCF. This message may be routed through I-CSCF#1 and/or I-CSCF#2, depending on operator configuration of I-CSCF#1 and I-CSCF#2.

23. MGCF sends an IP-IAM message to the T-SGW

24. T-SGW receives the IP-IAM and sends the SS7 IAM message into the PSTN.

25. When the PSTN has established the path to the destination, it may optionally alert the destination user before completing the call. If so, it responds with an SS7 ACM message

26. T-SGW sends an IP-ACM message to MGCF

27. If the PSTN is alerting the destination user, MGCF indicates this to the calling party by a provisional response indicating Ringing. This message is sent to I-CSCF.

28. I-CSCF forwards the message to S-CSCF. Based on the decision made in step #4 above, this message may be sent directly from I-CSCF#2 to S-CSCF (choice (a)), or may be routed through I-CSCF#1 (choice (b)).

29. S-CSCF performs whatever service control is appropriate for this ringing call.

30. S-CSCF forwards the message to P-CSCF

Editor's Note: Additional QoS interactions to handle one-way media at this point (e.g. for PSTN ringback and announcements) is for further study.

31. P-CSCF forwards the message to UE
32. UE indicates to the originator that the session is being delayed due to alerting. Typically this involves playing a ringback sequence.
33. When the called party answers, the PSTN sends an SS7 ANM message to T-SGW
34. T-SGW sends an IP-ANM message to MGCF
35. MGCF initiates a H.248 interaction to make the connection in the MGW bi-directional
36. MGCF sends a SIP 200-OK final response along the signaling path back to the call originator
37. I-CSCF sends a SIP 200-OK final response along the signaling path back to the call originator. Based on the decision made in step #4 above, this message may be sent directly from I-CSCF#2 to S-CSCF (choice (a)), or may be routed through I-CSCF#1 (choice (b)).
38. S-CSCF performs whatever service control logic is appropriate for this call completion
39. S-CSCF sends a SIP 200-OK final response to P-CSCF
40. P-CSCF approves the commitment of the QoS resources for this session
41. P-CSCF sends a SIP 200-OK final response along the signaling path back to the call originator
42. UE starts the media flow for this session
43. UE responds to the final response with a SIP ACK message, which is passed to the MGCF via the signaling path. The message is sent first to P-CSCF
44. P-CSCF forwards the ACK to S-CSCF.
45. S-CSCF forwards the ACK to MGCF. This message may be routed through I-CSCF#1 and/or I-CSCF#2, depending on operator configuration of I-CSCF#1 and I-CSCF#2.

B.9.2 Call Flow Decomposition into Procedure Blocks

The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.2, *(MO#2) Mobile origination, roaming, with visited network control of services*.

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.1, *(S-S#1) Different network operators performing origination and termination, with home control of termination*

The terminating part is for PSTN termination. This procedure is given in Section 5.8.4, *(PSTN-T) PSTN Termination*.

B.9.3 Issues

More study is required in how the I-CSCF selects the MGCF.

B.10 Sample end-end Call Flow - Mobile Origination, PSTN Termination by separate network operator

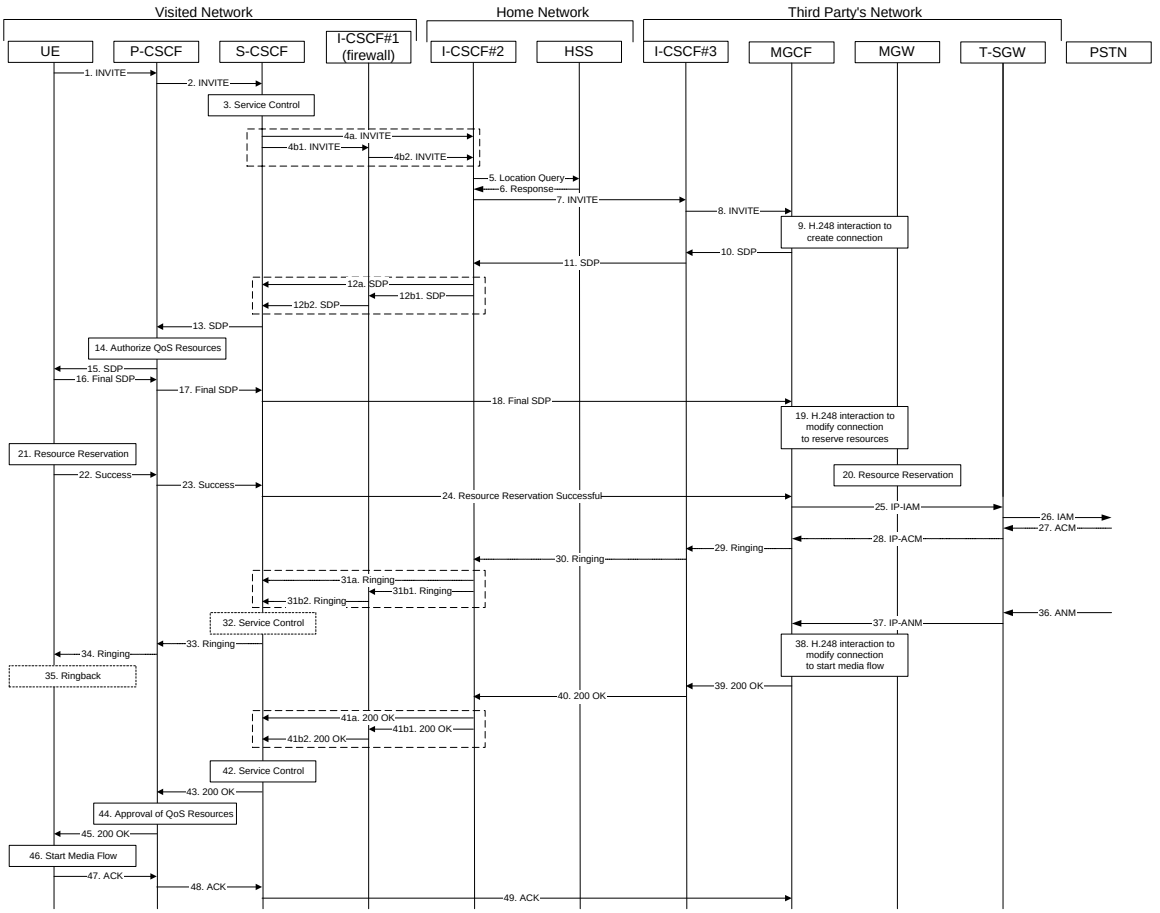
For this end-to-end call flow, we assume the originator is a mobile station located outside the service area of the network operator to whom the mobile station is subscribed. The mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. During registration the home network operator chose to accept the offer of visited control, and an S-CSCF has been chosen in the visited network.

The UE originating the call addresses a destination that is not a 3GPP endpoint, i.e. an E.164 number that must be completed by the PSTN.

The visited network operator decides not to perform the PSTN gateway function for this call attempt, rather to pass it to the subscriber's home network for call completion.

The network operator serving this subscriber decides to complete the call at a PSTN gateway of another network operator, the 'third party, with whom prior agreement has been made.

B.10.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

1. The UE sends a SIP INVITE request, containing an initial SDP, to the P-CSCF, which was obtained from the CSCF discovery procedures.

2. The P-CSCF forwards the INVITE to the next hop name/address, as determined from the registration procedures. In this case the next hop is the S-CSCF within the same operator's network.

3. The S-CSCF validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

4. The S-CSCF translates the destination address, and determines it is not a 3G endpoint. It decides to pass the call to the subscriber's home network operator for completion rather than completing the call locally. It therefore forwards the INVITE to the subscriber's home network operator's I-CSCF. The next hop is either I-CSCF#2 in UE#1's home network (choice (a)), or I-CSCF#1 in the visited network that is performing the configuration hiding function for the visited network operator (choice (b)). The S-CSCF performs number treatment so it has a meaning in the terminating network.

(4a) If the visited network operator does not desire to keep their network configuration hidden, the INVITE request is forwarded directly to I-CSCF#2

(4b) If the visited network operator desires to keep their network configuration hidden, the INVITE request is forwarded through I-CSCF#1 to I-CSCF#2

(4b1) S-CSCF forwards the INVITE request to I-CSCF#1 in the visited network

(4b2) I-CSCF#1 forwards the INVITE request to I-CSCF#2.

5. If I-CSCF#2 cannot determine, based on analysis of the destination number, that the HSS query will fail, then it will send 'Cx-location-query' to the HSS to obtain the location information for the destination. If I-CSCF#2 can determine, based on analysis of the destination number, that the HSS query will fail, it will not send the 'Cx-location-query' message, and continue with step #7

6. The HSS responds with 'Cx-location-query-response' and indicates the destination is not a mobile station, and therefore the call should be completed via the PSTN.

7. The I-CSCF#2 decides to use an MGW in a third party network, and forwards the INVITE request to I-CSCF#3, which is the entry point into that network.

8. I-CSCF#3 allocates a MGCF, and sends the INVITE request to the MGCF

9. MGCF initiates a H.248 interaction to pick an outgoing channel and determine media capabilities of the MGW.

10. MGCF determines the subset of the media flows proposed by the originating endpoint that it supports, and responds with an SDP message back to the originator via the signaling path. This response is sent to I-CSCF#3.

11. I-CSCF#3 forwards the SDP to I-CSCF#2

12. I-CSCF#2 forwards the SDP to S-CSCF. Based on the decision made in step #4 above, this message may be sent directly from I-CSCF#2 to S-CSCF (choice (a)), or may be routed through I-CSCF#1 (choice (b)).

13. S-CSCF forwards the SDP message to P-CSCF

14. P-CSCF authorizes the resources necessary for this session

15. P-CSCF forwards the SDP message to the originating endpoint, UE.

16. The originator decides the final set of media streams for this session, and sends the Final SDP to P-CSCF.

17. P-CSCF forwards the final SDP to S-CSCF

18. S-CSCF forwards the final SDP to MGCF. This message may be routed through I-CSCF#1 and/or I-CSCF#2 and/or I-CSCF#3, depending on operator configuration of I-CSCF#1, I-CSCF#2 and I-CSCF#3.

19. MGCF initiates a H.248 interaction to modify the connection established in step #9 and instruct MGW to reserve the resources necessary for the media stream.

20. MGW reserves the resources necessary for the media stream.

21. After determining the final set of media streams for this session, step #16 above, UE initiates the reservation procedures for the resources needed for this session.

22. When UE has successfully reserved the needed resources, it sends the "reservation successful" message to MGCF along the signaling path established by the INVITE message. This message is send first to P-CSCF.

23. P-CSCF forwards the message to S-CSCF.

24. S-CSCF forwards the message to MGCF. This message may be routed through I-CSCF#1 and/or I-CSCF#2 and/or I-CSCF#3, depending on operator configuration of I-CSCF#1, I-CSCF#2, and I-CSCF#3.

25. MGCF sends an IP-IAM message to the T-SGW

26. T-SGW receives the IP-IAM and sends the SS7 IAM message into the PSTN.

27. When the PSTN has established the path to the destination, it may optionally alert the destination user before completing the call. If so, it responds with an SS7 ACM message

28. T-SGW sends an IP-ACM message to MGCF

29. If the PSTN is alerting the destination user, MGCF indicates this to the calling party by a provisional response indicating Ringing. This message is sent to I-CSCF#3.

30. I-CSCF#3 forwards the message to I-CSCF#2

31. I-CSCF#2 forwards the message to S-CSCF. Based on the decision made in step #4 above, this message may be sent directly from I-CSCF#2 to S-CSCF (choice (a)), or may be routed through I-CSCF#1 (choice (b)).

32. S-CSCF performs whatever service control is appropriate for this ringing call.

33. S-CSCF forwards the message to P-CSCF

    Editor's Note: Additional QoS interactions to handle one-way media at this point (e.g. for PSTN ringback and announcements) is for further study.

34. P-CSCF forwards the message to UE

35. UE indicates to the originator that the session is being delayed due to alerting. Typically this involves playing a ringback sequence.

36. When the called party answers, the PSTN sends an SS7 ANM message to T-SGW

37. T-SGW sends an IP-ANM message to MGCF

38. MGCF initiates a H.248 interaction to make the connection in the MGW bi-directional

39. MGCF sends a SIP 200-OK final response along the signaling path back to the call originator

40. I-CSCF#3 sends a SIP 200-OK final response along the signaling path back to I-CSCF#2

41. I-CSCF#2 sends a SIP 200-OK final response along the signaling path back to S-CSCF. Based on the decision in step (4) above, this may be directly to S-CSCF, or may be via I-CSCF#1.

42. S-CSCF performs whatever service control logic is appropriate for this call completion

43. S-CSCF sends a SIP 200-OK final response along the signaling path back to P-CSCF

44. P-CSCF approves the commitment of the QoS resources for this session.

45. P-CSCF sends a SIP 200-OK final response along the signaling path back to the call originator

46. UE starts the media flow for this session.

47. UE responds to the final response with a SIP ACK message, which is passed to the MGCF via the signaling path. The message is sent first to P-CSCF.

48. P-CSCF forwards the ACK to S-CSCF.

49. S-CSCF forwards the ACK to MGCF. This message may be routed through I-CSCF#1 and/or I-CSCF#2 and/or I-CSCF#3, depending on operator configuration of I-CSCF#1, I-CSCF#2, and I-CSCF#3.

B.10.2 Call Flow Decomposition into Procedure Blocks

The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.2, *(MO#2) Mobile origination, roaming, with visited network control of services*..

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.2, *(S-S#2) Different network operators performing origination and termination, visited network control of termination*

The terminating part is for PSTN termination. This procedure is given in Section 5.8.4, *(PSTN-T) PSTN Termination*.

B.10.3 Issues

More study is required in how the I-CSCF selects the MGCF.

B.11 Sample end-end Call Flow - Mobile Origination, roaming with visited control, PSTN Termination by visited network

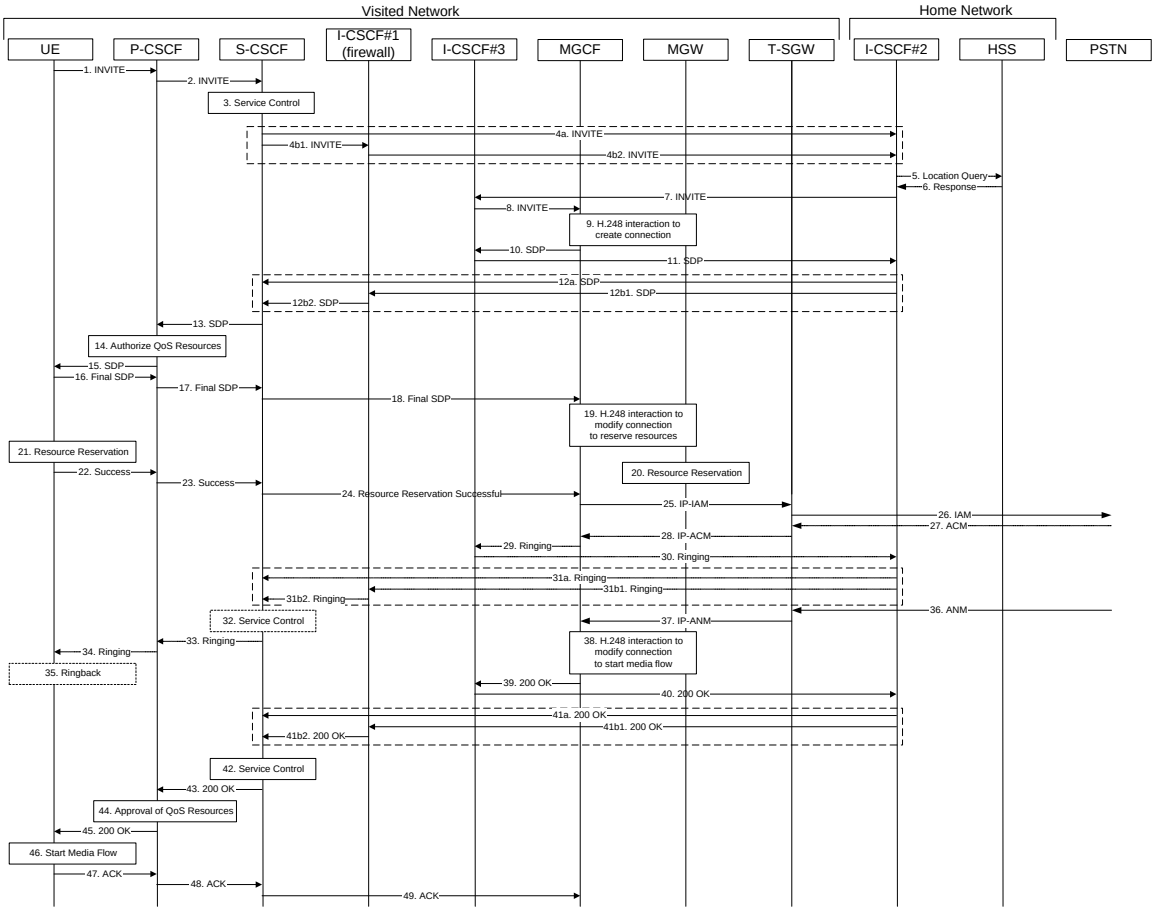
For this end-to-end call flow, we assume the originator is a mobile station located outside the service area of the network operator to whom the mobile station is subscribed. The mobile station has already established the proper PDP contexts for exchanging SIP signaling messages, has performed the proxy discovery procedures described in section 5.2.1, and has registered in the IM subsystem. During registration the home network operator chose to accept the offer of visited control, and an S-CSCF has been chosen in the visited network.

The UE originating the call addresses a destination that is not a 3GPP endpoint, i.e. an E.164 number that must be completed by the PSTN.

The visited network operator decides not to perform the PSTN gateway function for this call attempt, rather to pass it to the subscriber's home network for call completion.

The network operator serving this subscriber decides to complete the call at a PSTN gateway of the network operator where the subscriber is currently located, with whom prior agreement has been made.

B.11.1 Call Flow Diagram



Step-by-step processing of this end-to-end call flow is as follows:

1. The UE sends a SIP INVITE request, containing an initial SDP, to the P-CSCF, which was obtained from the CSCF discovery procedures.

2. The P-CSCF forwards the INVITE to the next hop name/address, as determined from the registration procedures. In this case the next hop is the S-CSCF within the same operator's network.

3. The S-CSCF validates the service profile, and performs whatever service control logic is appropriate for this call attempt.

4. The S-CSCF translates the destination address, and determines it is not a 3G endpoint. It decides to pass the call to the subscriber's home network operator for completion rather than completing the call locally. It therefore forwards the INVITE to the subscriber's home network operator's I-CSCF. The next hop is either I-CSCF#2 in UE#1's home network (choice (a)), or I-CSCF#1 in the visited network that is performing the configuration hiding function for the visited network operator (choice (b)). The S-CSCF performs number treatment so it has a meaning in the terminating network.

   (4a) If the visited network operator does not desire to keep their network configuration hidden, the INVITE request is forwarded directly to I-CSCF#2

   (4b) If the visited network operator desires to keep their network configuration hidden, the INVITE request is forwarded through I-CSCF#1 to I-CSCF#2

      (4b1) S-CSCF forwards the INVITE request to I-CSCF#1 in the visited network

      (4b2) I-CSCF#1 forwards the INVITE request to I-CSCF#2.

5. If I-CSCF#2 cannot determine, based on analysis of the destination number, that the HSS query will fail, then it will send 'Cx-location-query' to the HSS to obtain the location information for the destination. If I-CSCF#2 can determine, based on analysis of the destination number, that the HSS query will fail, it will not send the 'Cx-location-query' message, and continue with step #7

6. The HSS responds with 'Cx-location-query-response' and indicates the destination is not a mobile station, and therefore the call should be completed via the PSTN.

7. The I-CSCF#2 decides to use an MGW in a third party network, and forwards the INVITE request to I-CSCF#3, which is the entry point into that network.

8. I-CSCF#3 allocates a MGCF, and sends the INVITE request to the MGCF

9. MGCF initiates a H.248 interaction to pick an outgoing channel and determine media capabilities of the MGW.

10. MGCF determines the subset of the media flows proposed by the originating endpoint that it supports, and responds with an SDP message back to the originator via the signaling path. This response is sent to I-CSCF#3.

11. I-CSCF#3 forwards the SDP to I-CSCF#2

12. I-CSCF#2 forwards the SDP to S-CSCF. Based on the decision made in step #4 above, this message may be sent directly from I-CSCF#2 to S-CSCF (choice (a)), or may be routed through I-CSCF#1 (choice (b)).

13. S-CSCF forwards the SDP message to P-CSCF

14. P-CSCF authorizes the resources necessary for this session

15. P-CSCF forwards the SDP message to the originating endpoint, UE.

16. The originator decides the final set of media streams for this session, and sends the Final SDP to P-CSCF.

17. P-CSCF forwards the final SDP to S-CSCF

18. S-CSCF forwards the final SDP to MGCF. This message may be routed through I-CSCF#1 and/or I-CSCF#2 and/or I-CSCF#3, depending on operator configuration of I-CSCF#1, I-CSCF#2 and I-CSCF#3.

19. MGCF initiates a H.248 interaction to modify the connection established in step #9 and instruct MGW to reserve the resources necessary for the media stream.

20. MGW reserves the resources necessary for the media stream.

21. After determining the final set of media streams for this session, step #16 above, UE initiates the reservation procedures for the resources needed for this session.

22. When UE has successfully reserved the needed resources, it sends the “reservation successful” message to MGCF along the signaling path established by the INVITE message. This message is send first to P-CSCF.

23. P-CSCF forwards the message to S-CSCF.

24. S-CSCF forwards the message to MGCF. This message may be routed through I-CSCF#1 and/or I-CSCF#2 and/or I-CSCF#3, depending on operator configuration of I-CSCF#1, I-CSCF#2, and I-CSCF#3..

25. MGCF sends an IP-IAM message to the T-SGW

26. T-SGW receives the IP-IAM and sends the SS7 IAM message into the PSTN.

27. When the PSTN has established the path to the destination, it may optionally alert the destination user before completing the call. If so, it responds with an SS7 ACM message

28. T-SGW sends an IP-ACM message to MGCF

29. If the PSTN is alerting the destination user, MGCF indicates this to the calling party by a provisional response indicating Ringing. This message is sent to I-CSCF#3.

30. I-CSCF#3 forwards the message to I-CSCF#2

31. I-CSCF#2 forwards the message to S-CSCF. Based on the decision made in step #4 above, this message may be sent directly from I-CSCF#2 to S-CSCF (choice (a)), or may be routed through I-CSCF#1 (choice (b)).

32. S-CSCF performs whatever service control is appropriate for this ringing call.

33. S-CSCF forwards the message to P-CSCF

    Editor’s Note: Additional QoS interactions to handle one-way media at this point (e.g. for PSTN ringback and announcements) is for further study.

34. P-CSCF forwards the message to UE

35. UE indicates to the originator that the session is being delayed due to alerting. Typically this involves playing a ringback sequence.

36. When the called party answers, the PSTN sends an SS7 ANM message to T-SGW

37. T-SGW sends an IP-ANM message to MGCF

38. MGCF initiates a H.248 interaction to make the connection in the MGW bi-directional

39. MGCF sends a SIP 200-OK final response along the signaling path back to the call originator

40. I-CSCF#3 sends a SIP 200-OK final response along the signaling path back to I-CSCF#2

41. I-CSCF#2 sends a SIP 200-OK final response along the signaling path back to S-CSCF. Based on the decision in step (4) above, this may be directly to S-CSCF, or may be via I-CSCF#1.

42. S-CSCF performs whatever service control logic is appropriate for this call completion

43. S-CSCF sends a SIP 200-OK final response along the signaling path back to P-CSCF

44. P-CSCF approves the commitment of the QoS resources for this session.

45. P-CSCF sends a SIP 200-OK final response along the signaling path back to the call originator

46. UE starts the media flow for this session.

47. UE responds to the final response with a SIP ACK message, which is passed to the MGCF via the signaling path. The message is sent first to P-CSCF.

48. P-CSCF forwards the ACK to S-CSCF.

49. S-CSCF forwards the ACK to MGCF. This message may be routed through I-CSCF#1 and/or I-CSCF#2 and/or I-CSCF#3, depending on operator configuration of I-CSCF#1, I-CSCF#2, and I-CSCF#3.

B.11.2 Call Flow Decomposition into Procedure Blocks

The end-to-end call flow given in the previous section can be decomposed into an originating part, an inter-serving part, and a terminating part.

The originating part is for a mobile origination, with subscriber located in the home operator service area. This procedure is given in Section 5.7.2, *(MO#2) Mobile origination, roaming, with visited network control of services*..

The inter-serving part is for a single operator, where the called party is located within the operator's service area. This procedure is given in Section 5.6.2, *(S-S#2) Different network operators performing origination and termination, visited network control of termination*

The terminating part is for PSTN termination. This procedure is given in Section 5.8.4, *(PSTN-T) PSTN Termination*.

B.11.3 Issues

More study is required in how the I-CSCF selects the MGCF.

Annex <C> (Informative): Call Flow Procedures

C.1 Overview of Call Flow Procedures

This informative annex is to contain the overview description and list of individual procedures for the end-to-end call flows. When stable, this text will be moved to section 5.5.

For a UE-UE call, the call flow procedures are shown in the following diagram.

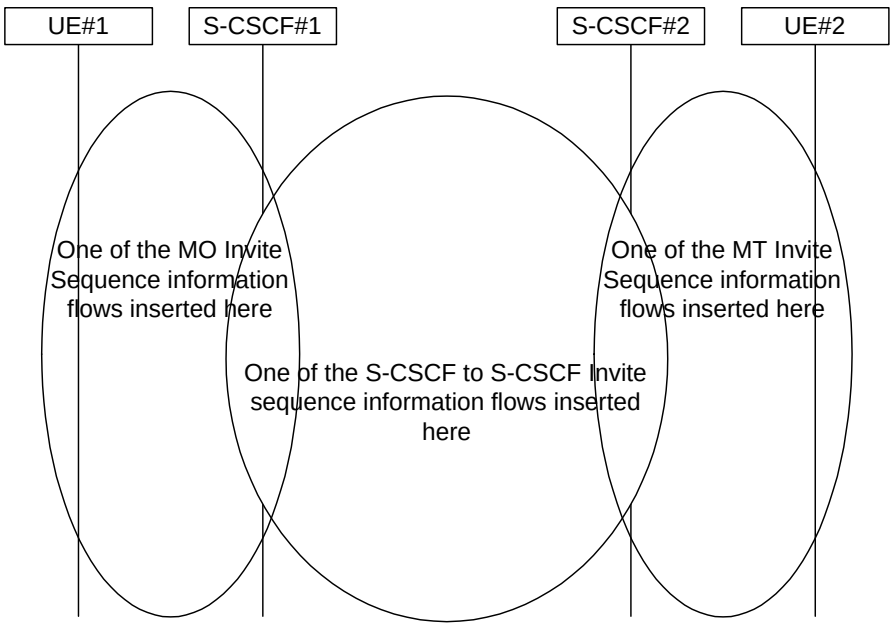


Figure 1: Overview of Call Flow Sections

The following procedures are defined:

For the origination sequence:

- (MO#1) Mobile origination, roaming, home control of services
- (MO#2) Mobile origination, roaming, with visited network control of services
- (MO#3) Mobile origination, located in home network
- (PSTN-O) PSTN origination (where the S-CSCF is a MGCF)

For the termination sequence:

- (MT#1) Mobile termination, roaming, home control of services
- (MT#2) Mobile termination, roaming, with visited network control of services
- (MT#3) Mobile termination, located in home network
- (PSTN-T) PSTN termination (where the S-CSCF is a MGCF)

For Serving-CSCF/MGCF-to-Serving-CSCF/MGCF sequences:

- (S-S#1) Call origination and termination are served by different network operators, with home control at termination.
- (S-S#2) Call origination and termination are served by different network operators, termination is done by visited network control.
- (S-S#3) Call origination and termination are served by the same operator, with home control at termination.
- (S-S#4) Call origination and termination are served by the same operator, termination is done by visited network control.

For example, for a roaming subscriber calling another roaming subscriber, each a subscriber of a different network operator, it is possible to construct a complete end-to-end call flow from the following procedures:

- (MO#1) Mobile origination, roaming, home control
- (S-S#1) Different network operators, termination with home control
- (MT#1) Mobile termination, roaming, home control

Further, assume the originating network operator and the home network operator desire to keep their configuration hidden. An informative example of this call flow is given in Annex C.1

There are a total of 120 end-to-end call flows defined by these procedures. They are built from combinations of origination, serving-serving, and termination procedures, as determined from the following table. For each row of the table, any one of the listed origination procedures can be combined with any one of the serving-serving procedures, which can be combined with any one of the termination procedures. In addition, several of the procedures give alternatives for network configuration hiding (the number of such alternatives is shown in parentheses).

Origination Procedure (pick one)	Serving-CSCF-to-Serving-CSCF Procedure (pick one)	Termination Procedure (pick one)
MO#1 Mobile origination, roaming, home control of services (2). MO#2 Mobile origination, roaming, with visited control of services. MO#3 Mobile origination, located in home service area. PSTN-O PSTN origination.	S-S#1 Different network operators performing origination and termination, with home control of termination (2). S-S#3 Single network operator performing origination and termination, with home control of termination.	MT#1 Mobile termination, roaming, home control of services(2). MT#3 Mobile termination, located in home service area. PSTN-T PSTN termination.
MO#1 Mobile origination, roaming, home control of services (2). MO#2 Mobile origination, roaming, with visited control of services. MO#3 Mobile origination, located in home service area. PSTN-O PSTN origination.	S-S#2 Different network operators performing origination and termination, visited network control of termination (4). S-S#4 Call origination and termination are served by the same operator, termination is done by visited network control (2).	MT#2 Mobile termination, roaming, with visited control of services. PSTN-T PSTN termination.

C.2 Serving CSCF (MGCF) to Serving-CSCF (MGCF) Procedures

Annex <B.2> presents the detailed application level flows to define the procedures for Serving-CSCF to Serving-CSCF. This informative Annex is to be used as the basis for further work within SA2. When stable, this text will be moved to section 5.6.

This section contains four call flow procedures, showing variations on the signaling path between the Serving-CSCF that handles call origination, and the Serving-CSCF that handles call termination. This signaling path depends on:

- whether the originator and destination are served by the same network operator,
- whether the destination subscriber is roaming under visited-network control, and
- whether the network operators have chosen to hide their internal configuration.

The Serving-CSCF handling call origination performs an analysis of the destination address, and determines whether it is a subscriber of the same network operator or a different operator.

If the analysis of the destination address determined that it belongs to a subscriber of a different operator, the request is forwarded (optionally through an I-CSCF within the originating operator's network) to a well-known entry point in the destination operator's network, the I-CSCF. The I-CSCF queries the HSS for current location information. The I-CSCF then forwards the request to the S-CSCF (if located in the home area, or roaming with home control – procedure S-S#1) or, for roaming with visited network control, to the address given during registration by the visited network (procedure S-S#2). The entry point in the visited network is either an I-CSCF to hide the visited network configuration or directly to the S-CSCF in the visited network.

If the analysis of the destination address determines that it belongs to a subscriber of the same operator, the S-CSCF passes the request to a local I-CSCF, who queries the HSS for current location information. The I-CSCF then forwards the request to the S-CSCF (if located in the home area, or roaming with home control – procedure S-S#3) or, for roaming with visited network control, to the address given during registration by the visited network (procedure (S-

S#4). The entry point in the visited network is either an I-CSCF to hide the visited network configuration or directly to the S-CSCF in the visited network.

C.2.1 (S-S#1) Different network operators performing origination and termination, with home control of termination.

The Serving-CSCF handling call origination performs an analysis of the destination address, and determines that it belongs to a subscriber of a different operator. The request is therefore forwarded (optionally through an I-CSCF within the originating operator's network) to a well-known entry point in the destination operator's network, the I-CSCF. The I-CSCF queries the HSS for current location information, and finds the subscriber either located in the home service area, or roaming with home control. The I-CSCF therefore forwards the request to the S-CSCF serving the destination subscriber.

Origination sequences that share this common S-S procedure are:

MO#1 Mobile origination, roaming, home control of services. The "Originating Network" of S-S#1 is therefore a visited network, and S-CSCF#1 is located in the home network.

MO#2 Mobile origination, roaming, with visited control of services. The "Originating Network" of S-S#1 is therefore a visited network, and S-CSCF#1 is also located in the visited network.

MO#3 Mobile origination, located in home service area. The "Originating Network" of S-S#1 is therefore the home network, and S-CSCF#1 is also located in the home network.

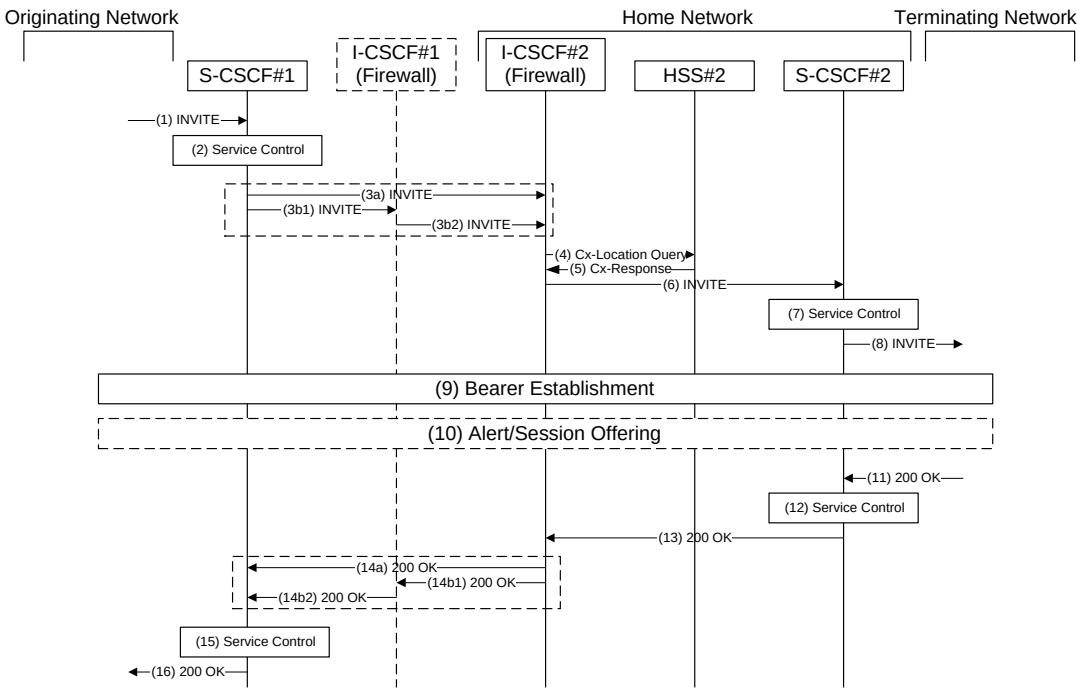
PSTN-O PSTN origination. The "Originating Network" of S-S#1 is the home network. The elements labelled UE#1 and S-CSCF#1 are combined into the single MGCF of the PSTN-O procedure.

Termination sequences that share this common S-S procedure are:

MT#1 Mobile termination, roaming, home control of services. The "Terminating Network" of S-S#1 is a visited network.

MT#3 Mobile termination, located in home service area. The "Terminating Network" of S-S#1 is the home network.

PSTN-T PSTN termination. The "Terminating Network" of S-S#1 is the home network. The elements labelled S-CSCF#2 and UE#2 are combined into the single MGCF of the PSTN-T procedure.



Procedure S-S#1 is as follows:

1. The SIP INVITE request is sent from the UE to S-CSCF#1 by the procedures of the originating flow.

2. S-CSCF#1 performs whatever service control logic is appropriate for this call attempt.

3. S-CSCF#1 performs an analysis of the destination address, and determines the network operator to whom the subscriber belongs. For S-S#1, flow (2) is an inter-operator message to the I-CSCF entry point for the terminating subscriber. If the originating operator desires to keep their internal configuration hidden, then S-CSCF#1 forwards the INVITE request through an I-CSCF (choice (b)); otherwise S-CSCF#1 forwards the INVITE request directly to I-CSCF#2, the well-known entry point into the terminating subscriber's network (choice (a)).

   (3a) If the originating network operator does not desire to keep their network configuration hidden, the INVITE request is sent directly to I-CSCF#2.

   (3b) If the originating network operator desires to keep their network configuration hidden, the INVITE request is forwarded through an I-CSCF in the originating operator's network, I-CSCF#1.

   (3b1) The INVITE request is sent from S-CSCF#1 to I-CSCF#1

   (3b2) I-CSCF#1 performs the configuration-hiding modifications to the request and forwards it to I-CSCF#2

4. I-CSCF (at the border of the terminating subscriber's network) queries the HSS for current location information.

5. HSS responds with the address of the current Serving-CSCF for the terminating subscriber.

6. I-CSCF forwards the INVITE request to the S-CSCF that will handle the call termination.

7. S-CSCF#2 performs whatever service control logic is appropriate for this call attempt

8. The sequence continues with the message flows determined by the termination procedure.

9. Bearer path authorization and establishment, which will require additional SIP messages to carry the bearer information of the called party back to the calling party

10. The alerting phase, if required, which may require additional SIP messages to carry the indication from the called party back to the calling party11. The SIP final response, 200-OK, is passed back to UE#1 over the signaling path. This is typically generated by UE#2 when the subscriber has accepted the incoming call attempt.

12. S-CSCF#2 performs whatever service control logic is appropriate for this call completion

13. The 200-OK is passed to the I-CSCF#2.

14. The 200-OK is passed to the S-CSCF#1 using the optional I-CSCF#1 if required.

15. S-CSCF#1 performs whatever service control logic is appropriate for this call completion

16. The 200-OK is returned to the originating network.

C.2.2 (S-S#2) Different network operators performing origination and termination, visited network control of termination.

The Serving-CSCF handling call origination performs an analysis of the destination address, and determines that it belongs to a subscriber of a different operator. The request is therefore forwarded (optionally through an I-CSCF within the originating operator's network) to a well-known entry point in the destination operator's network, the I-CSCF. The I-CSCF queries the HSS for current location information, and finds the subscriber is roaming with visited network control. The I-CSCF therefore forwards the request to the entry point provided by the visited network during registration. If the visited network did not want to hide their internal configuration, then this entry point was the S-CSCF serving the destination subscriber; otherwise it is an I-CSCF within the visited network.

Origination sequences that share this common S-S procedure are:

MO#1 Mobile origination, roaming, home control of services. The "Originating Network" of S-S#2 is therefore a visited network, and S-CSCF#1 is located in the home network.

MO#2 Mobile origination, roaming, with visited control of services. The "Originating Network" of S-S#2 is therefore a visited network, and S-CSCF#1 is also located in the visited network.

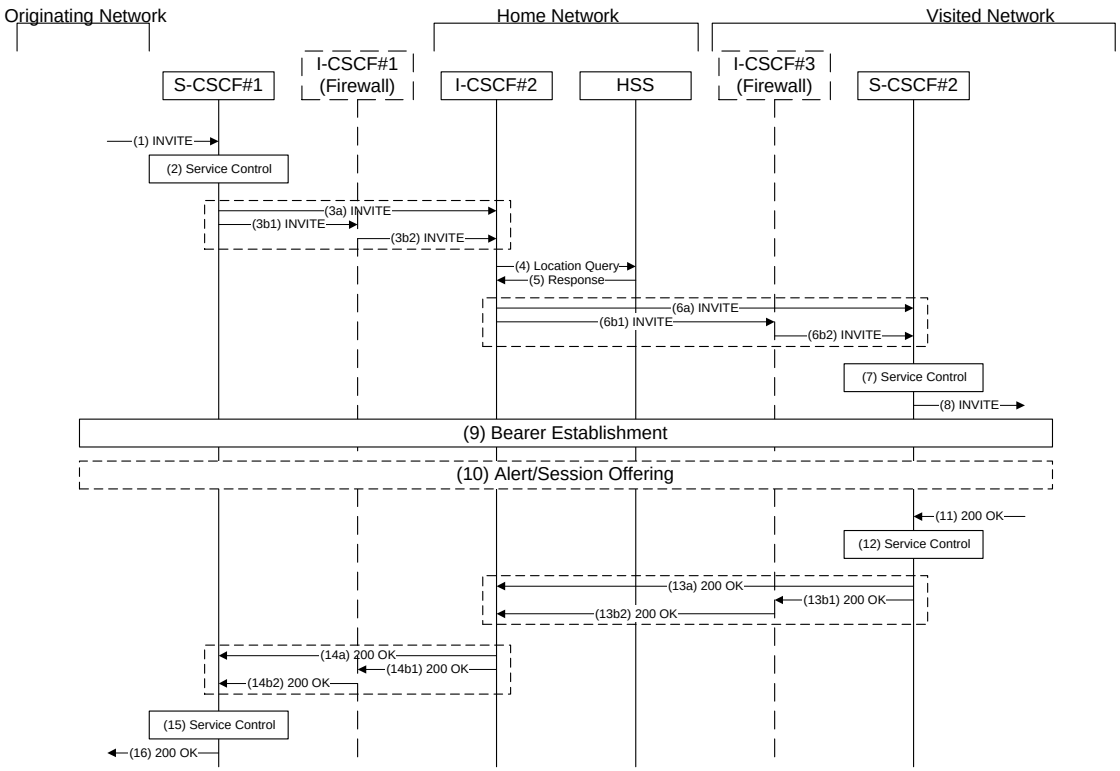
MO#3 Mobile origination, located in home service area. The "Originating Network" of S-S#2 is therefore the home network, and S-CSCF#1 is also located in the home network.

PSTN-O PSTN origination. The "Originating Network" of S-S#2 is the home network. The element S-CSCF#1 is the MGCF of the PSTN-O procedure.

Termination sequences that share this common S-S procedure are:

MT#2 Mobile termination, roaming, with visited control of services.

PSTN-T PSTN termination. The element labeled S-CSCF#2 is the MGCF of the PSTN-T procedure. This only occurs if there is an agreement between the network operators for termination of PSTN calls in the visited network.



Procedure S-S#2 is as follows:

1. The SIP INVITE request is sent from the UE to S-CSCF#1 by the procedures of the originating flow.

2. S-CSCF#1 performs whatever service control logic is appropriate for this call attempt

3. S-CSCF#1 performs an analysis of the destination address, and determines the network operator to whom the subscriber belongs. In this case it determines the destination subscriber belongs to a different network operator. Flow (2) is an inter-operator message to the I-CSCF entry point for the terminating subscriber. If the originating operator desires to keep their internal configuration hidden, then S-CSCF#1 forwards the INVITE request through an I-CSCF (choice (b)); otherwise S-CSCF#1 forwards the INVITE request directly to I-CSCF#2, the well-known entry point into the terminating subscriber's network (choice (a)).

   (3a) If the originating network operator does not desire to keep their network configuration hidden, the INVITE request is sent directly to I-CSCF#2.

   (3b) If the originating network operator desires to keep their network configuration hidden, the INVITE request is forwarded through I-CSCF#1 in the originating operator's network.

   (3b1) The INVITE request is sent from S-CSCF#1 to I-CSCF#1

   (3b2) I-CSCF#1 performs the configuration-hiding modifications to the request and forwards it to I-CSCF#2

4. I-CSCF#2 queries the HSS for current location information.

5. HSS responds with the address of the current Serving-CSCF for the terminating subscriber.

6. I-CSCF#2 forwards the INVITE request to the entry point whose address was provided during registration. This entry point is either the S-CSCF that is serving the visiting UE (choice (a)), or an I-CSCF within the visited network that is performing the configuration hiding function for the visited network operator (choice (b)).

   (6a) If the visited network operator does not desire to keep their network configuration hidden, the name/address of the S-CSCF was provided during registration, and the INVITE request is forwarded directly to S-CSCF#2.

(6b) If the visited network operator desires to keep their network configuration hidden, the name/address of an I-CSCF in the visited network was provided during registration, I-CSCF#3, and the INVITE request is forwarded through I-CSCF#3 to S-CSCF#2.

(6b1) I-CSCF#2 forwards the INVITE request to I-CSCF#3

(6b2) I-CSCF#3 forwards the INVITE request to S-CSCF#2

7. S-CSCF#2 performs whatever service control logic is appropriate for the call attempt.

8. The sequence continues with the message flows determined by the termination procedure.

9. The originating and terminating UE co-operatively establish the bearer path for the media flow.

10. The called UE may optionally perform alerting. If so, it signals this to the calling party.

11. When the called party answers, the termination procedure results in a SIP 200-OK final response being sent to S-CSCF#2

12. S-CSCF#2 performs whatever service control logic is appropriate for the call completion.

13. S-CSCF#2 sends the SIP 200-OK final response along the signaling path back to the call originator. Based on the choice made in (5) above, this response may either be sent directly from S-CSCF#2 to I-CSCF#2 (choice (a)), or be sent indirectly through I-CSCF#3 (Firewall) (choice (b)).

14. I-CSCF#2 sends the SIP 200-OK final response along the signaling path back to the call originator. Based on the choice made in (2) above, this response may either be sent directly from I-CSCF#2 to S-CSCF#1 (choice (a)), or be sent indirectly through I-CSCF#1 (Firewall) (choice (b)).

15. S-CSCF#1 performs whatever service control logic is appropriate for the call completion.

16. S-CSCF#1 continues by the procedures of the originating flow

C.2.3 (S-S#3) Single network operator performing origination and termination, with home control of termination.

The Serving-CSCF handling call origination performs an analysis of the destination address, and determines that it belongs to a subscriber of the same operator. The request is therefore forwarded to a local I-CSCF. The I-CSCF queries the HSS for current location information, and finds the subscriber either located in the home service area, or roaming with home control. The I-CSCF therefore forwards the request to the S-CSCF serving the destination subscriber.

Origination sequences that share this common S-S procedure are:

MO#1 Mobile origination, roaming, home control of services. The “Originating Network” of S-S#3 is therefore a visited network, and S-CSCF#1 is located in the home network.

MO#2 Mobile origination, roaming, with visited control of services. The “Originating Network” of S-S#3 is therefore a visited network, and S-CSCF#1 is also located in the visited network.

MO#3 Mobile origination, located in home service area. The “Originating Network” of S-S#3 is therefore the home network, and S-CSCF#1 is also located in the home network.

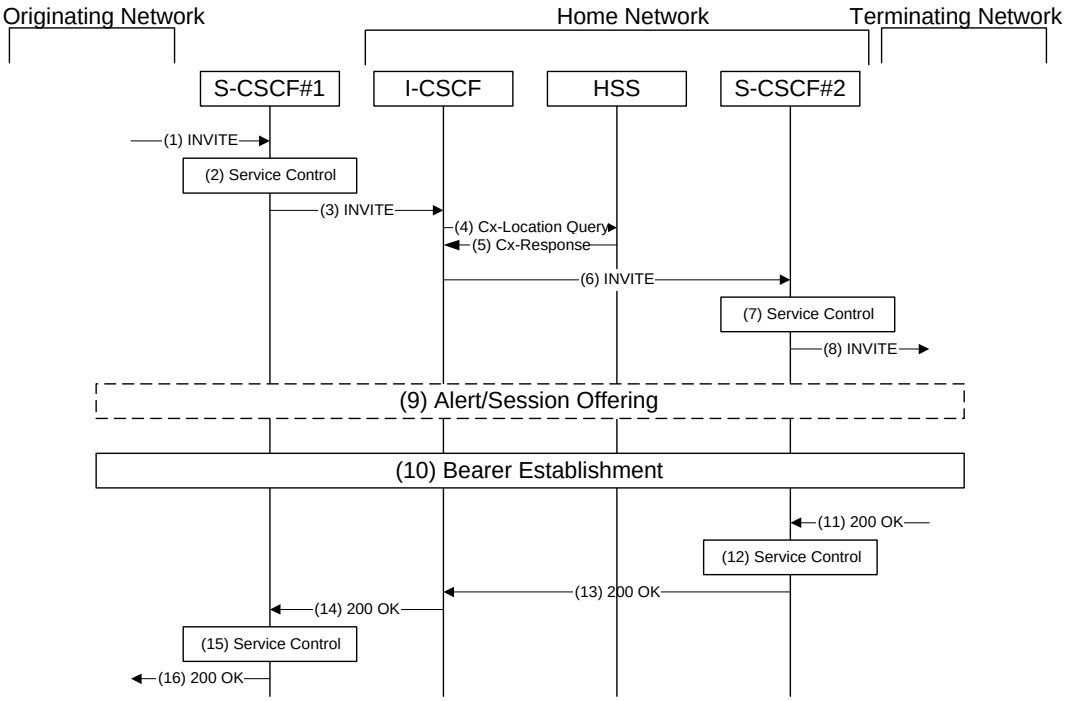
PSTN-O PSTN origination. The “Originating Network” of S-S#3 is the home network. The elements labelled UE#1 and hS-CSCF#1 are combined into the single MGCF of the PSTN-O procedure.

Termination sequences that share this common S-S procedure are:

MT#1 Mobile termination, roaming, home control of services. The “Terminating Network” of S-S#3 is a visited network.

MT#3 Mobile termination, located in home service area. The “Terminating Network” of S-S#3 is the home network.

PSTN-T PSTN termination. The “Terminating Network” of S-S#3 is the home network. The elements labelled S-CSCF#2 and UE#2 are combined into the single MGCF of the PSTN-T procedure.



Procedure S-S#3 is as follows:

1. The SIP INVITE request is sent from the UE to S-CSCF#1 by the procedures of the originating flow.
2. S-CSCF#1 performs whatever service control logic is appropriate for this call attempt
3. S-CSCF#1 performs an analysis of the destination address, and determines the network operator to whom the subscriber belongs. Since it is local, the request is passed to a local I-CSCF.
4. I-CSCF queries the HSS for current location information.
5. HSS responds with the address of the current Serving-CSCF for the terminating subscriber.
6. I-CSCF forwards the INVITE request to the S-CSCF that will handle the call termination.
7. S-CSCF#2 performs whatever service control logic is appropriate for this call attempt
8. The sequence continues with the message flows determined by the termination procedure.
9. Bearer path authorization and establishment, which will require additional SIP messages to carry the bearer information of the called party back to the calling party
10. The alerting phase, if required, which may require additional SIP messages to carry the indication from the called party back to the calling party
11. The SIP final response, 200-OK, is passed back to UE#1 over the signaling path. This is typically generated by UE#2 when the subscriber has accepted the incoming call attempt.
12. S-CSCF#2 performs whatever service control logic is appropriate for this call completion
13. The 200-OK is passed to the I-CSCF
14. The 200-OK is passed to the S-CSCF#1
15. S-CSCF#1 performs whatever service control logic is appropriate for this call completion
16. The 200-OK is passed to the Originating Network

C.2.4 (S-S#4) Call origination and termination are served by the same operator, termination is done by visited network control.

The Serving-CSCF handling call origination performs an analysis of the destination address, and determines that it belongs to a subscriber of the same operator. The request is therefore forwarded to a local I-CSCF. The I-CSCF queries the HSS for current location information, and finds the subscriber is roaming with visited network control. The I-CSCF therefore forwards the request to the entry point provided by the visited network during registration. If the visited network did not want to hide their internal configuration, then this entry point was the S-CSCF serving the destination subscriber; otherwise it is an I-CSCF within the visited network.

Origination sequences that share this common S-S procedure are:

MO#1 Mobile origination, roaming, home control of services. The "Originating Network" of S-S#4 is therefore a visited network, and S-CSCF#1 is located in the home network.

MO#2 Mobile origination, roaming, with visited control of services. The "Originating Network" of S-S#4 is therefore a visited network, and S-CSCF#1 is also located in the visited network.

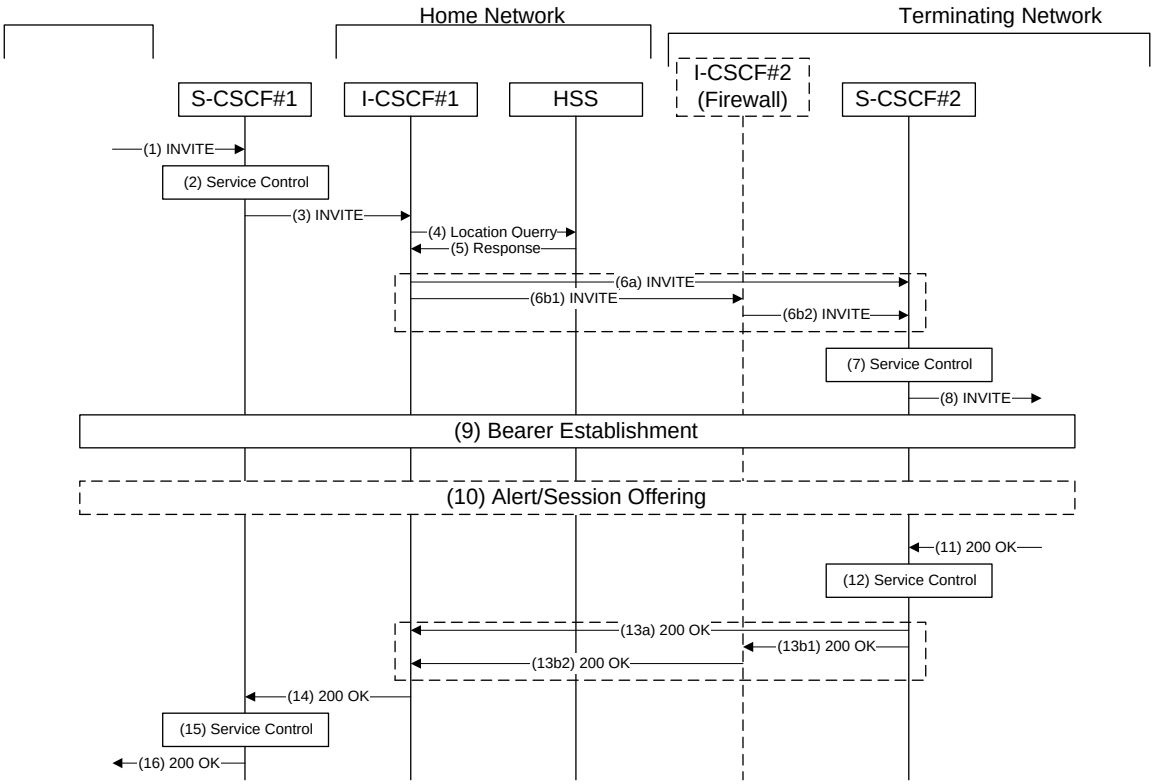
MO#3 Mobile origination, located in home service area. The "Originating Network" of S-S#4 is therefore the home network, and S-CSCF#1 is also located in the home network.

PSTN-O PSTN origination. The "Originating Network" of S-S#4 is the home network. The element S-CSCF#1 is the MGCF of the PSTN-O procedure.

Termination sequences that share this common S-S procedure are:

MT#2 Mobile termination, roaming, with visited control of services.

PSTN-T PSTN termination. The element labeled S-CSCF#2 is the MGCF of the PSTN-T procedure. This only occurs if there is an agreement between the network operators for termination of PSTN calls in the visited network.



Procedure S-S#4 is as follows:

1. The SIP INVITE request is sent from the UE to S-CSCF#1 by the procedures of the originating flow.

2. S-CSCF#1 performs whatever service control logic is appropriate for this call attempt

3. S-CSCF#1 performs an analysis of the destination address, and determines the network operator to whom the subscriber belongs. Since it is local, the request is passed to a local I-CSCF, I-CSCF#1.

4. I-CSCF#1 queries the HSS for current location information.

5. HSS responds with the address of the current Serving-CSCF for the terminating subscriber.

6. I-CSCF#1 forwards the INVITE request to the entry point whose address was provided during registration. This entry point is either the S-CSCF that is serving the visiting UE (choice (a)), or an I-CSCF within the visited network that is performing the configuration hiding function for the visited network operator (choice (b)).

   (6a) If the visited network operator does not desire to keep their network configuration hidden, the name/address of S-CSCF#2 was provided during registration, and the INVITE request is forwarded directly to S-CSCF#2.

   (6b) If the visited network operator desires to keep their network configuration hidden, the name/address of an I-CSCF in the visited network was provided during registration, and the INVITE request is forwarded through I-CSCF#2 (Firewall) to S-CSCF#2.

   (6b1) I-CSCF#1 forwards the INVITE request to I-CSCF#2 (Firewall)

   (6b2) I-CSCF#2 (Firewall) forwards the INVITE request to S-CSCF#2

7. S-CSCF#2 performs whatever service control is appropriate for this call attempt

8. S-CSCF#2 continues processing the call attempt using the terminating procedures.

9. The originating and terminating UE co-operatively establish the bearer path for the media flow.

10. The called UE may optionally perform alerting. If so, it signals this to the calling party.

11. When the called party answers, the termination procedure results in a SIP 200-OK final response being sent to S-CSCF#2

12. S-CSCF#2 performs whatever service control is appropriate for this call completion

13. S-CSCF#2 sends the SIP 200-OK final response along the signaling path back to the call originator. Based on the choice made in (6) above, this response may either be sent directly from S-CSCF#2 to I-CSCF#1 (choice (a)), or be sent indirectly through I-CSCF#2 (Firewall) (choice (b)).

14. I-CSCF#1 sends a SIP 200-OK final response along the signaling path back to S-CSCF#1

15. S-CSCF#1 performs whatever service control is appropriate for this call completion

16. S-CSCF#1 continues by the procedures of the originating flow

C.3 Origination Procedures

Annex <B.3> presents the detailed application level flows to define the Procedures for call originations. This informative Annex is to be used as the basis for further work within SA2. When stable, this text will be moved to section 5.7.

. The call origination procedures specify the signaling path between the UE initiating a call attempt and the Serving-CSCF that is assigned to perform the call origination service. This signaling path is determined at the time of UE registration, and remains fixed for the life of the registration.

A UE always has a proxy (P-CSCF) associated with it. This P-CSCF is located in the same network as the UE, performs resource authorization, and may have additional functions in handling of emergency calls. The P-CSCF is determined by the CSCF discovery process, described in Section 5.2.1 (Local CSCF Discovery).

As a result of the registration procedure, the P-CSCF determines the next hop toward the Serving-CSCF. This next hop may be directly to the S-CSCF in the same network (MO#2 for the roaming case, MO#3 for the home case), or to the S-CSCF in the home network (possibly through an I-CSCF to hide the network configuration) (MO#1). These next-hop addresses could be IPv4/IPv6 addresses, or could be names that are translated via DNS to an IPv4/IPv6 address.

The mechanism by which P-CSCF retains the next-hop address is for further study. The mechanism by which I-CSCF retains the next-hop address in procedure MO#1 is also for further study.

Calls originated in the PSTN to a mobile destination are a special case of the Origination procedures. The MGCF uses H.248/MEGACO to control a Media Gateway, and communicates with the SS7 network via the TSGW. The MGCF initiates the SIP request, and, for signaling purposes, acts as a combined UE and S-CSCF.

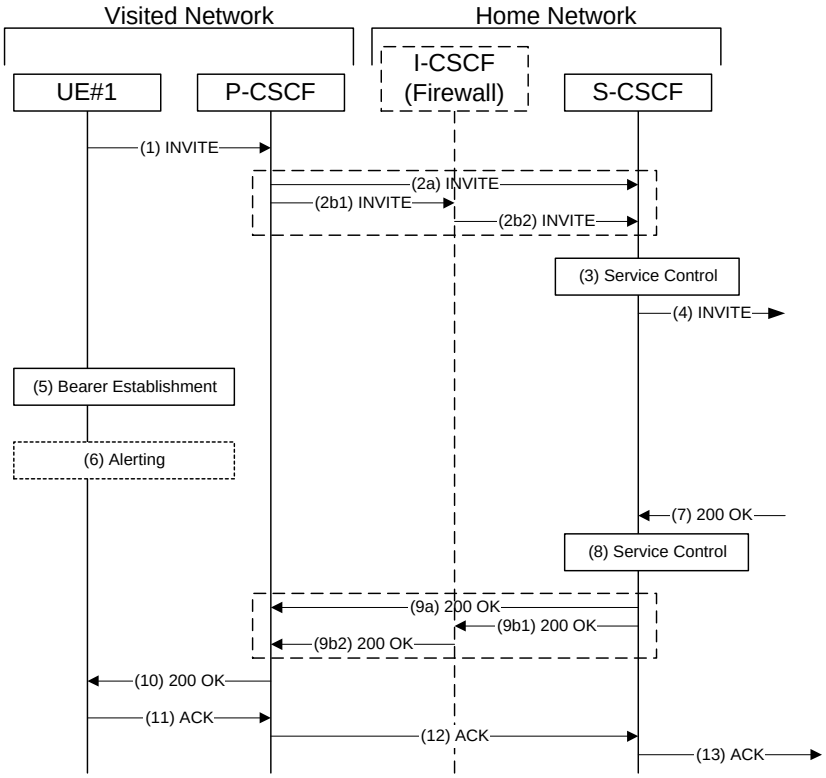
C.3.1 (MO#1) Mobile origination, roaming, with home control of services

This origination procedure applies to roaming subscribers under home control.

The UE is located in a visited network, and determines the P-CSCF via the CSCF discovery procedure described in section 5.2.1. During registration, the home network decides to exercise home control of calls by this UE, and therefore allocates an S-CSCF in the home network. The home network advertises either the S-CSCF or an I-CSCF as the entry point from the visited network.

When registration is complete, P-CSCF knows the name/address of the next hop in the signaling path toward the serving-CSCF, either I-CSCF (if the home network wanted to hide their internal configuration) or S-CSCF (if there was no desire to hide the network configuration). I-CSCF, if it exists in the signaling path, knows the name/address of S-CSCF.

Editor's note: The mechanism by which the P-CSCF identifies the I-CSCF and the mechanism by which the I-CSCF identifies the S-CSCF is FFS.



Procedure MO#1 is as follows:

1. UE sends the SIP INVITE request to the P-CSCF determined via the CSCF discovery mechanism.
2. P-CSCF remembers (from the registration procedure) the next hop CSCF for this UE.
3. This next hop is either the S-CSCF that is serving the visiting UE (choice (a)), or an I-CSCF within the home network that is performing the configuration hiding function for the home network operator (choice (b)).

   (2a) If the home network operator does not desire to keep their network configuration hidden, the name/address of the S-CSCF was provided during registration, and the INVITE request is forwarded directly to the S-CSCF.

   (2b) If the home network operator desires to keep their network configuration hidden, the name/address of an I-CSCF in the home network was provided during registration, and the INVITE request is forwarded through this I-CSCF to the S-CSCF.

   (2b1) P-CSCF forwards the INVITE request to I-CSCF

   (2b2) I-CSCF forwards the INVITE request to S-CSCF

3. S-CSCF performs any origination service control required by this subscriber.
4. S-CSCF forwards the request, as specified by the S-S procedures.
5. The originating UE and the terminating UE co-operatively establish the bearer path for the media flow.
6. The called UE may optionally perform alerting. If so, it signals this to the calling party.
7. When the called party answers, the called UE sends a SIP 200-OK final response, as specified by the termination procedures and the S-S procedures, to S-CSCF.
8. S-CSCF performs whatever service control is appropriate for the completed call
9. S-CSCF sends a SIP 200-OK final response along the signaling path back to the call originator. Based on the choice made in (2) above, this response may either be sent directly from S-CSCF to P-CSCF (choice (a)), or be sent indirectly through I-CSCF firewall (choice (b)).

10. P-CSCF sends a SIP 200-OK final response to the call originator

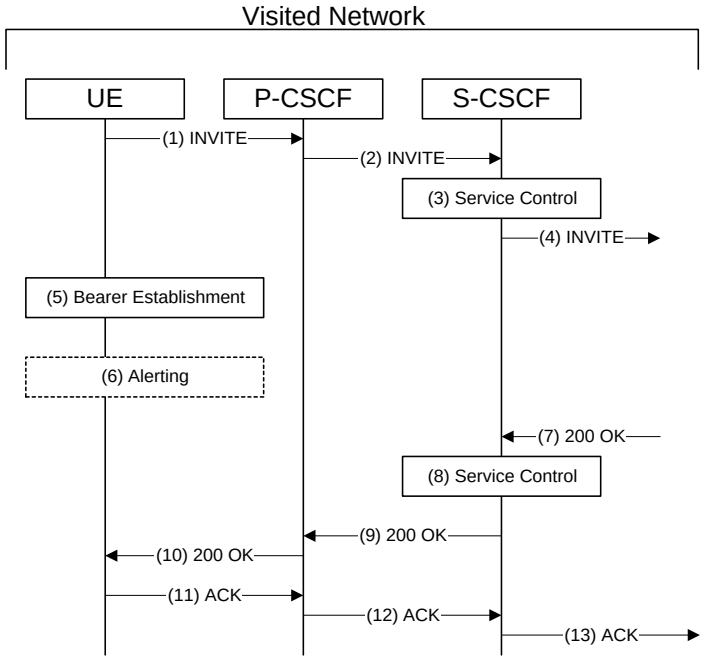
11-13. UE responds to the final response with a SIP ACK message which is forwarded via the P-CSCF and S-CSCF.

C.3.2 (MO#2) Mobile origination, roaming, with visited network control of services

This origination procedure applies to roaming subscribers, under visited network control.

The UE is located in a visited network, and determines the P-CSCF via the CSCF discovery procedure described in section 5.2.1. During registration, the home network decides to accept an offer of visited network control of calls by this UE, and therefore the visited network allocates an S-CSCF.

When registration is complete, P-CSCF knows the name/address of S-CSCF.



Procedure MO#2 is as follows:

1. UE sends the SIP INVITE request to the P-CSCF determined via the CSCF discovery mechanism.
2. P-CSCF remembers (from the registration procedure) the next hop CSCF for this UE. This next hop is the S-CSCF that is serving the visiting UE.
3. S-CSCF performs any origination service control required by this subscriber.
4. S-CSCF forwards the request, as specified by the S-S procedures.
5. The originating UE and the terminating UE co-operatively establish the bearer path for the media flow.
6. The called UE may optionally perform alerting. If so, it signals this to the calling party.
7. When the called party answers, the called UE sends a SIP 200-OK final response, as specified by the termination procedures and the S-S procedures, to S-CSCF.
8. S-CSCF performs whatever service control is appropriate for the completed call
9. S-CSCF sends a SIP 200-OK final response along the signaling path back to the call originator.
10. P-CSCF sends a SIP 200-OK final response to the call originator

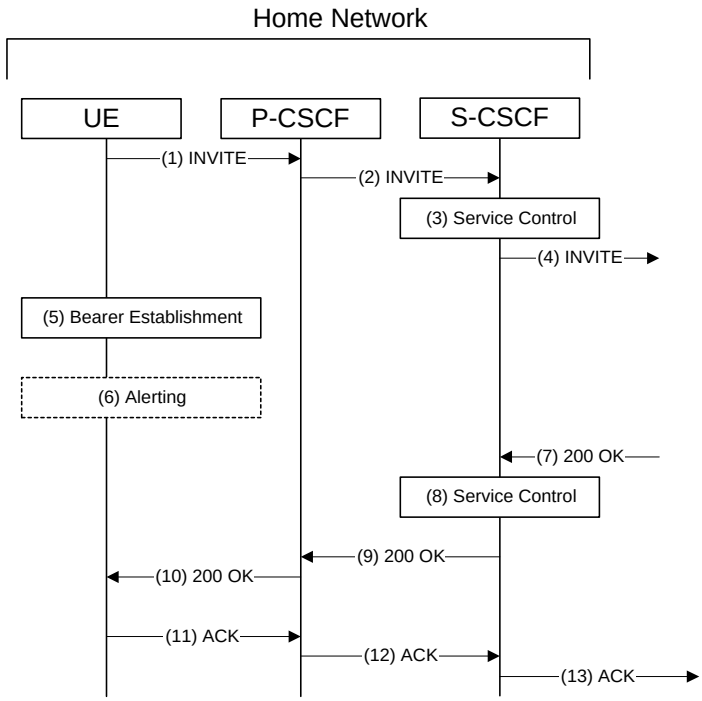
11-13. UE responds to the final response with a SIP ACK message which is forwarded via the P-CSCF and the S-CSCF.

C.3.3 (MO#3) Mobile origination, located in home network

This origination procedure applies to subscribers located in their home service area.

The UE is located in the home network, and determines the P-CSCF via the CSCF discovery procedure described in section 5.2.1. During registration, the home network allocates an S-CSCF in the home network.

When registration is complete, P-CSCF knows the name/address of S-CSCF.



Procedure MO#4 is as follows:

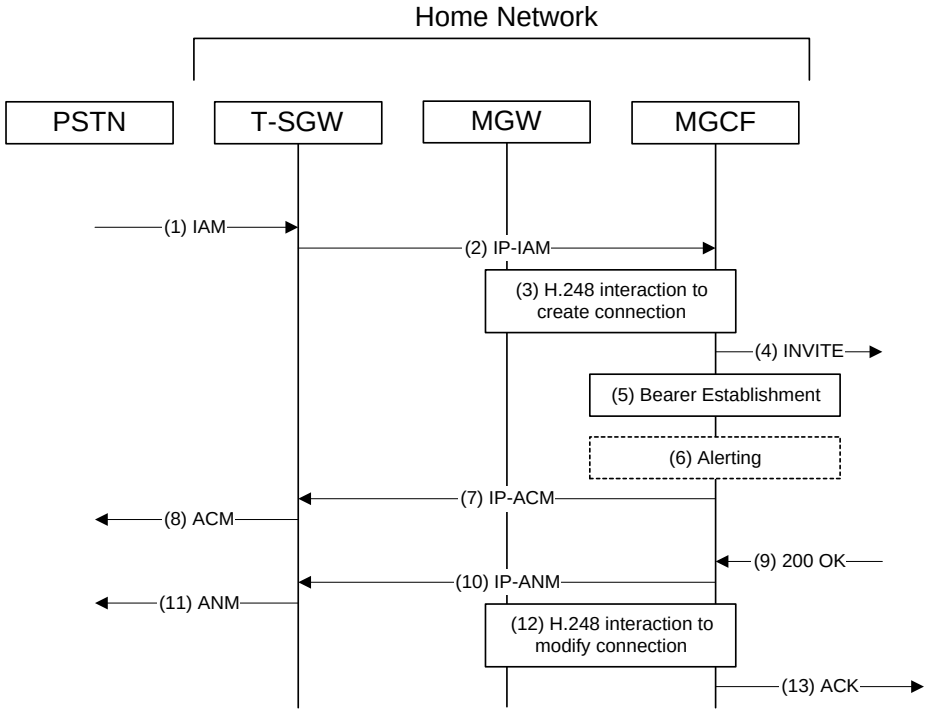
1. UE#1 sends the SIP INVITE request to the P-CSCF determined via the CSCF discovery mechanism.
2. P-CSCF remembers (from the registration procedure) the next hop CSCF for this UE. In this case it forwards the INVITE to the S-CSCF in the home network.
3. S-CSCF performs any origination service control required by this subscriber.
4. S-CSCF forwards the request, as specified by the S-S procedures.
5. UE#1 establishes the bearer path for this session
6. UE#1 provides ringback in response to alerting at the destination
7. The SIP final response, 200-OK, is passed back to S-CSCF over the signaling path. This is typically generated by UE#2 when the subscriber has accepted the incoming call attempt.
8. S-CSCF performs any origination service control required by call completion.
9. S-CSCF passes the 200-OK response back to P-CSCF, following the path of the INVITE request of step (2) above.
10. P-CSCF passes the 200-OK response back to UE#1

11-13. UE#1 responds to the SIP final response with an ACK message which is forwarded via the P-CSCF and the S-CSCF.

C.3.4 (PSTN-O) PSTN origination

The MGCF in the IM subsystem is a SIP endpoint that initiates requests on behalf of the PSTN and Media Gateway. The subsequent nodes consider the signaling as if it came from an S-CSCF. The MGCF incorporates the network security functionality of the S-CSCF. This MGCF does not invoke Service Control, as this may be carried out in the GSTN or at the terminating S-CSCF. This origination procedure can be used for any of the S-S procedures.

Due to routing of calls within the PSTN, this origination procedure will only occur in the home network of the destination subscriber. However, due to the possibility of visited network control, the destination subscriber may be in a different operator's network. Further, due to cases of call forwarding and electronic surveillance, the destination of the call through the IM subsystem may actually be another PSTN termination.



The PSTN Origination procedure is as follows:

1. The PSTN establishes a bearer path to the MGW, and signals to the T-SGW with a SS7 IAM message, giving the trunk identity and destination information
2. The T-SGW forwards the SS7 message, encapsulated in IP, to the MGCF.
3. The MGCF initiates a H.248 command, to seize the trunk and an IP port.
4. The MGCF initiates a SIP INVITE request, as per the proper S-S procedure.
5. The MGW and the terminating UE co-operatively establish the bearer path for the media flow
6. The called UE may optionally perform alerting. If so, it signals this to the calling party
7. If alerting is being performed, the MGCF forwards an IP-ACM message to T-SGW
8. If alerting is being performed, the T-SGW forwards a SS7 ACM message
9. When the called party answers, the terminating and S-S procedures result in a SIP 200-OK final response being sent to MGCF
10. MGCF forwards an IP-ANM message to T-SGW
11. T-SGW forwards an ANM message to the PSTN

12. MGCF initiates a H.248 command to alter the connection at MGW to make it bi-directional

13. MGCF acknowledges the SIP final response with a SIP ACK message

C.4 Termination Procedures

Annex <B.4> presents the detailed application level flows to define the Procedures for call terminations. This informative Annex is to be used as the basis for further work within SA2. When stable, this text will be moved to section 5.8.

The call termination procedures specify the signaling path between the Serving-CSCF assigned to perform the call termination service and the UE. This signaling path is determined at the time of UE registration, and remains fixed for the life of the registration. This signaling path is the reverse of the call initiation signaling path of Section 5.7. Therefore there is a one-to-one correspondence between the origination procedures of section 5.7 and the termination procedures of this section.

A UE always has a proxy (P-CSCF) associated with it. This P-CSCF is located in the same network as the UE, and performs resource authorization for the calls to the UE. The P-CSCF is determined by the CSCF discovery process, described in Section 5.2.1 (Local CSCF Discovery).

As a result of the registration procedure, the P-CSCF knows the address of the UE. The assigned S-CSCF, either in the home or visited network, knows the name/address of the P-CSCF (procedure MT#2, MT#3, and MT#4, depending on the location of S-CSCF and P-CSCF). If the network operator owning the S-CSCF wants to keep their configuration private, the S-CSCF will have chosen an Interrogating-CSCF, I-CSCF, who will perform the firewall functions and pass messages to the P-CSCF (procedure MT#1).

The mechanism by which S-CSCF retains the name/address of P-CSCF (and I-CSCF, if needed) is for further study.

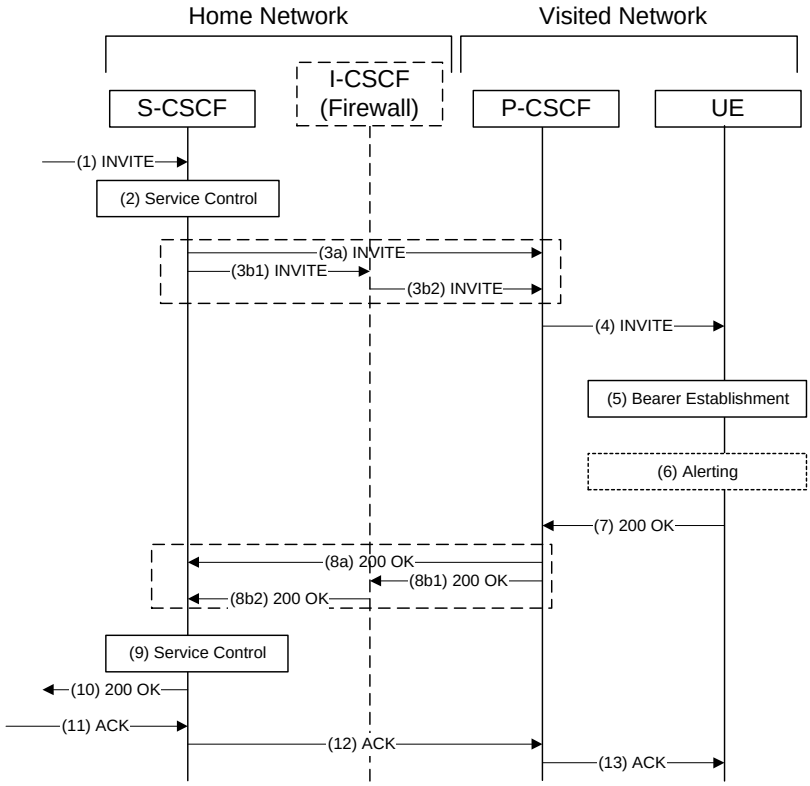
Calls destined to the PSTN are a special case of the Termination procedures. The MGCF uses H.248/MEGACO to control a Media Gateway, and communicates with the SS7 network via the T-SGW. The MGCF receives and processes SIP requests, and, for signaling purposes, acts as a combined S-CSCF and UE.

C.4.1 (MT#1) Mobile termination, roaming, with home control of services

This termination procedure applies to roaming subscribers under home control.

The UE is located in a visited network, and determines the P-CSCF via the CSCF discovery procedure described in section 5.2.1. During registration, the home network decides to exercise home control of calls to/from this UE, and therefore allocates an S-CSCF in the home network. The home network advertises either the S-CSCF, or an I-CSCF firewall, as the entry point from the visited network.

When registration is complete, S-CSCF knows the name/address of its next hop in the signaling path, either I-CSCF or P-CSCF, I-CSCF (if it exists) knows the name/address of P-CSCF, and P-CSCF knows the name/address of the UE. The mechanism by which this information is stored is for further study.



Procedure MT#1 is as follows:

1. The calling party sends the SIP INVITE request, via one of the origination procedures, and via one of the Inter-Serving procedures, to the Serving-CSCF for the terminating subscriber.

2. S-CSCF performs any termination service control required by this subscriber

3. S-CSCF remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE to the P-CSCF in the visited network, possibly through an I-CSCF.

4. This next hop is either the P-CSCF that is serving the visiting UE (choice (a)), or an I-CSCF within the home network that is performing the configuration hiding function for the home network operator (choice (b)).

   (3a) If the home network operator does not desire to keep their network configuration hidden, the INVITE request is forwarded directly to the P-CSCF.

   (3b) If the home network operator desires to keep their network configuration hidden, the INVITE request is forwarded through an I-CSCF to the P-CSCF.

   (3b1) S-CSCF forwards the INVITE request to I-CSCF

   (3b2) I-CSCF forwards the INVITE request to P-CSCF

4. P-CSCF remembers (from the registration procedure) the UE address, and forwards the INVITE to the UE.

5. UE co-operatively with the call originator, establishes the bearer path for the media flow.

6. UE may alert the user and wait for an indication from the user before completing the call. If so, it indicates this to the calling party through the alerting procedure.

7. When the called party answers, the UE sends a SIP 200-OK final response to P-CSCF

8. P-CSCF sends a SIP 200-OK final response along the signaling path back to the S-CSCF
   Based on the choice made in (3) above, this response may either be sent directly from P-CSCF to S-CSCF (choice (a)), or be sent indirectly through the I-CSCF firewall (choice (b)).

9. S-CSCF performs whatever service control is required for the call completion

10. S-CSCF forwards the SIP 200-OK final response along the signaling path back to the call originator.

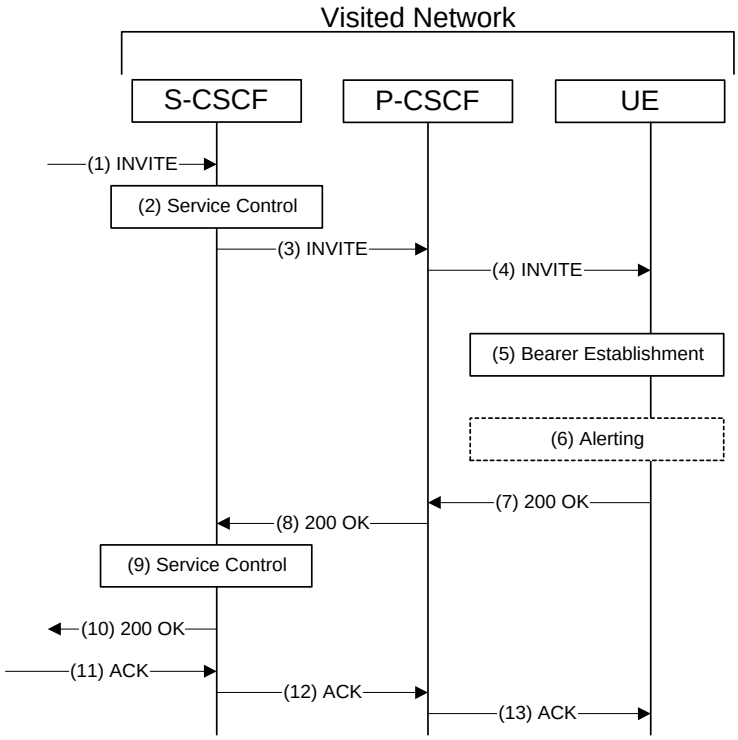
11-13. The calling party responds to the 200-OK final response with a SIP ACK message which is forwarded via the S-CSCF and the P-CSCF.

C.4.2 (MT#2) Mobile termination, roaming, with visited network control of services

This termination procedure applies to roaming subscribers, under visited network control.

The UE is located in a visited network, and determines the P-CSCF via the CSCF discovery procedure described in section 5.2.1. During registration, the home network decided to accept an offer of visited network control of calls by/to this UE, and therefore the visited network allocates the S-CSCF.

When registration is complete, S-CSCF knows the name/address of P-CSCF, and P-CSCF knows the name/address of the UE. The mechanism by which this information is stored is for further study.



Procedure MT#2 is as follows:

1. The caller sends the SIP INVITE request, via one of the origination procedures, and via one of the Inter-Serving CSCF procedures, to the Serving-CSCF for the terminating subscriber.

2. S-CSCF performs any termination service control required by this subscriber

3. S-CSCF remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE to the P-CSCF in the visited network.

4. P-CSCF remembers (from the registration procedure) the UE address, and forwards the INVITE to the UE.

5. UE, co-operatively with the call originator, establishes the bearer path for the media flow.

6. UE may alert the user and wait for an indication from the user before completing the call. If so, it indicates this to the calling party through the alerting procedure.

7. When the called party answers, UE sends a SIP 200-OK final response to P-CSCF.

8. P-CSCF sends a SIP 200-OK final response along the signaling path to S-CSCF.

9. S-CSCF performs whatever service control is required for the call completion

10. S-CSCF forwards the SIP 200-OK final response along the signaling path back to the call originator

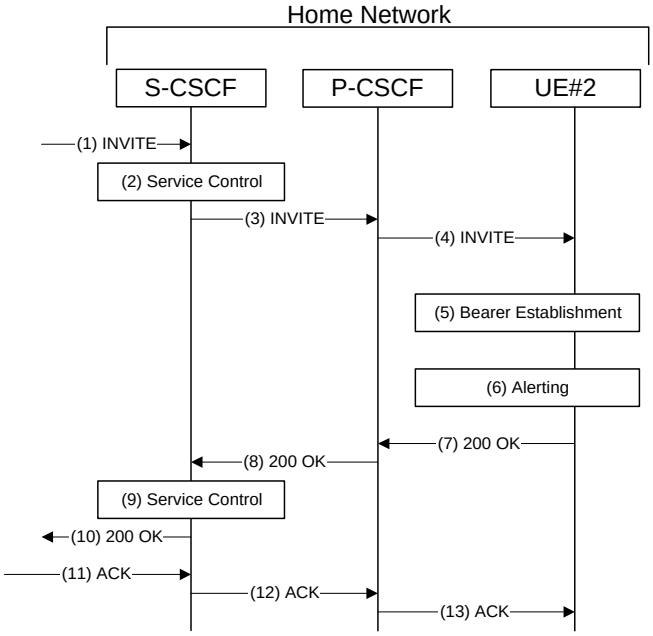
11-13. The calling party responds to the 200-OK final response with a SIP ACK message which is forwarded via the S-CSCF and the P-CSCF.

C.4.3 (MT#3) Mobile termination, located in home network

This termination procedure applies to subscribers located in their home service area.

The UE is located in the home network, and determines the hP-CSCF via the CSCF discovery procedures described in section 5.2.1. During registration, the home network allocates an S-CSCF in the home network, hS-CSCF.

When registration is complete, hS-CSCF knows the name/address of hP-CSCF, and hP-CSCF knows the name/address of the UE.



Procedure MT#3 is as follows:

(1) UE#1 sends the SIP INVITE request, via one of the origination procedures, and via one of the Serving-Serving CSCF procedures, to the Serving-CSCF for the terminating subscriber.

(2) S-CSCF performs any termination service control required by this subscriber

(3) S-CSCF remembers (from the registration procedure) the next hop CSCF for this UE. It forwards the INVITE to the P-CSCF in the home network.

(4) P-CSCF remembers (from the registration procedure) the UE address, and forwards the INVITE to the UE.

(5) UE#2 establishes the bearer path for this call

(6) UE#2 alerts the user

(7) UE#2 generates the SIP final response, 200-OK, when the subscriber accepts the incoming call.

(8) P-CSCF forwards the 200-OK to S-CSCF, following the path of the INVITE request in step (3) above

(9) S-CSCF performs any service control required on call completion.

(10) S-CSCF forwards the 200-OK final response, as per the appropriate S-S procedure.

11-13. The call originator responds to the 200-OK by sending the ACK message to UE#2 via the S-CSCF and the P-CSCF.

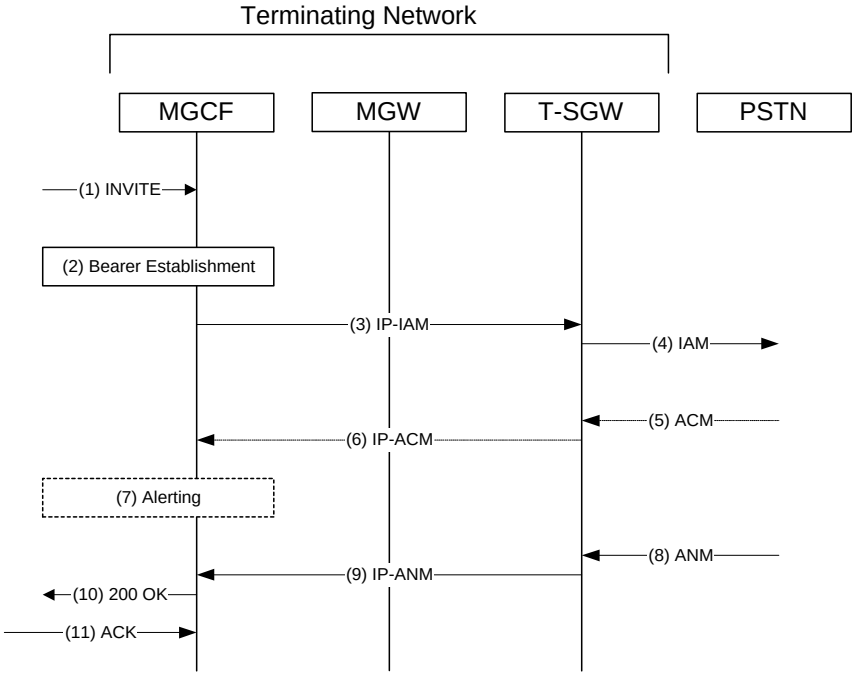
C.4.4 (PSTN-T) PSTN termination

The MGCF in the IM subsystem is a SIP endpoint that initiates and receives requests on behalf of the PSTN and Media Gateway (MGW). Other nodes consider the signaling as if it came from an S-CSCF. The MGCF incorporates the network security functionality of the S-CSCF.

PSTN termination may be done in the same operator's network as the S-CSCF of the call originator, e.g. the visited network for visited network control or the home network for home network control. Therefore, the location of the MGCF/MGW/T-SGW is given only as "Terminating Network" rather than "Home Network" or "Visited Network."

Further, agreements between network operators may allow PSTN termination in a network other than the originator's visited network or home network. This may be done, for example, to avoid long distance or international tariffs.

This termination procedures can be used for any of the inter-serving procedures, in place of the S-CSCF.



The PSTN termination procedure is as follows:

1. MGCF receives an INVITE request, through one of the origination procedures and via one of the inter-serving procedures.
2. MGCF initiates the establishment of the bearer path between the calling party and the MGW
3. MGCF sends an IP-IAM message to the T-SGW
4. T-SGW receives the IP-IAM and sends the SS7 IAM message into the PSTN.
5. The PSTN establishes the path to the destination. It may optionally alert the destination user before completing the call. If so, it responds with an SS7 ACM message
6. If the PSTN is alerting the destination user, T-SGW sends an IP-ACM message to MGCF
7. If the PSTN is alerting the destination user, MGCF and the calling party co-operatively perform the alerting function for the originating user.
8. When the called party answers, the PSTN sends an SS7 ANM message to T-SGW

9. T-SGW sends an IP-ANM message to MGCF
10. MGCF sends a SIP 200-OK final response along the signaling path back to the call originator
11. The Calling party acknowledges the final response with a SIP ACK message

Annex <D> (informative): Interaction between QoS and Call Signaling

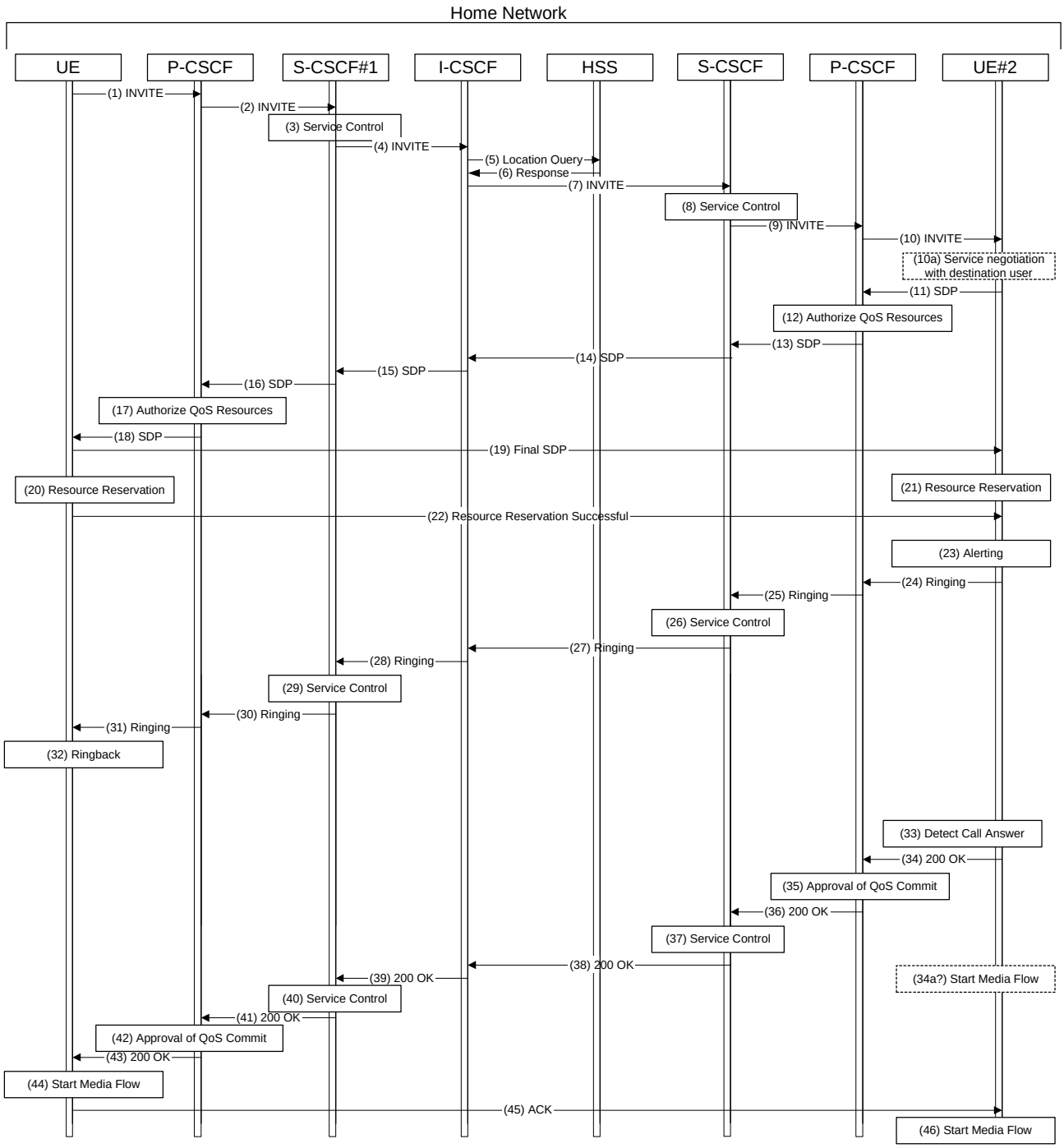
The GGSN contains a Policy Enforcement Function that has the capability of monitoring packet flow into the IP network, and restricting the set of IP destinations that may be reached from/through a PDP context. This 'gate' function has an external control interface that allows it to be selectively 'opened' or 'closed' on a per-destination basis – when open the gate allows packets to pass through (to the particular destination), and when closed no packets are allowed to pass through.

There are six interactions between the CSCF and the above Policy Enforcement Function (possibly via a Policy Control Function external to the GGSN):

1. authorization for UMTS resource allocation, giving the bandwidth allowed
2. authorization for IP resources (i.e. beyond the GGSN), giving both bandwidth and destination address for the media stream. This establishes the 'gate' described above.
3. enable media stream authorized in (2), e.g. 'open' the 'gate'
4. disable media stream authorized in (2), e.g. 'close' the 'gate'
5. release UMTS and IP resources
6. Indication from the GGSN to the CSCF of PDP Context modification/release (when no path is available for signaling messages) may be needed based on response from N1.

There are four interactions between the UE and the QoS allocation/enforcement elements:

1. allocate the UMTS resources, within the previous authorization from the CSCF
2. allocate the IP resources (i.e. beyond the GGSN), within the previous authorization from the CSCF
3. utilize the UMTS and IP resources to send media packets
4. release UMTS and IP resources



Annex <E> (informative): Base for Contribution - Supplementary Services Procedures

Editor's Note: The material in this Annex relating to Authentication Procedures needs to be reviewed with S3. A presentation is to be made at their first meeting following the November Makuhari meeting of S2.

5.12.X Caller-ID Procedures

This section gives information flows for the procedures for providing authenticated Caller-ID and Calling-Name information to the destination subscriber. It also describes the mechanisms for blocking the display of Caller-ID if requested by the originator.

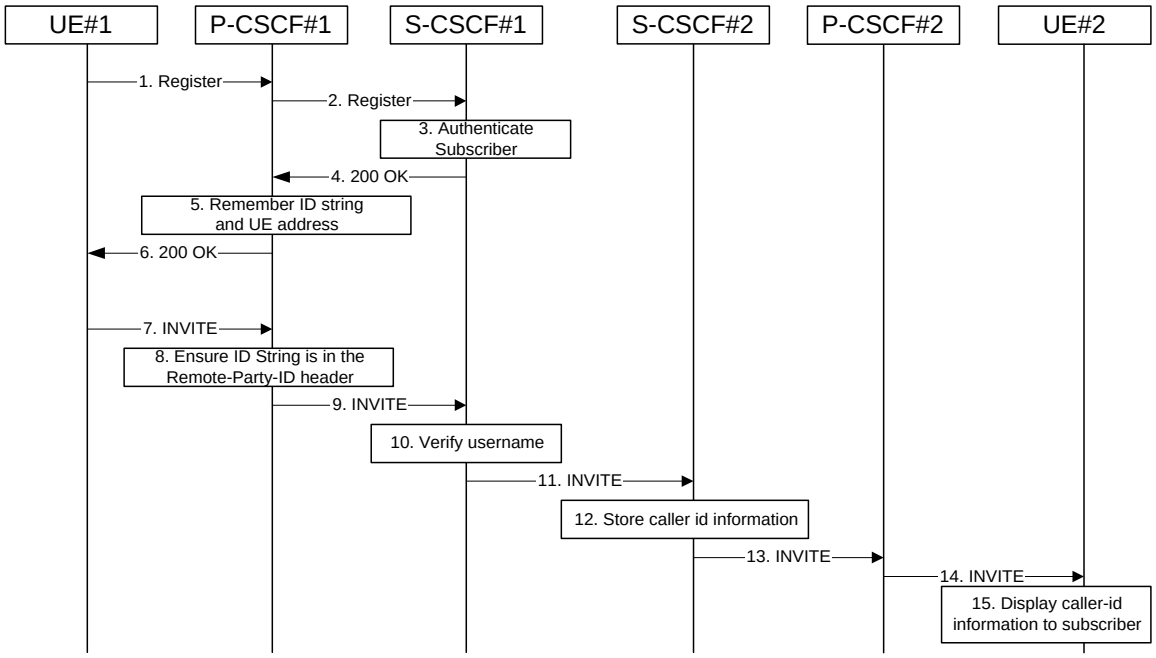
5.12.X.1 Procedures for Providing Authenticated Caller-ID

Authentication of the subscriber is performed during the registration procedures, as described in section 5.3.2.4. As a result of the registration procedures, the URL of UE#1 is stored in P-CSCF#1, and the list of possible user names associated with UE#1 is stored in S-CSCF#1. This is shown in the following information flow in steps 1-6.

When UE#1 attempts to initiate a new session, it includes this URL in the INVITE request. P-CSCF#1 verifies that it is present and correct before passing the request to S-CSCF#1. S-CSCF#1 then verifies the user-name supplied by UE#1 against the list of possible user-names configured for the subscriber. Thus the INVITE request sent between S-CSCFs will always have authenticated caller-identification information.

If the URL supplied by UE#1 in the INVITE request is incorrect, P-CSCF may reject the request, or may overwrite with the correct URL.

If the user-name supplied by UE#1 in the INVITE request is incorrect, S-CSCF may reject the request, or may overwrite with a default user-name for the subscriber.



The detailed procedure is as follows:

1. UE#1 initiates a registration request, using the procedures of section 5.3.2. In this REGISTER request is included a URL identifying the UE, and sufficient information to meet the authentication requirements of SA3.

2. P-CSCF#1 forwards the REGISTER request as specified by the procedures of section 5.3.2.4. This message is processed by various other network elements, not shown in this figure, until it reaches the S-CSCF assigned for this subscriber (S-CSCF#1). S-CSCF#1 may be either in the home network or in the visited network.

3. S-CSCF#1 performs authentication procedures, as specified by SA3. In the profile information retrieved from the HSS is the set of possible user-names associated with this subscription.

4. S-CSCF#1 returns a successful registration indication through the path of the REGISTER message, until it reaches P-CSCF#1.

5. P-CSCF#1 stores the URL that identifies the subscriber, and sufficient additional information to accurately identify all requests that originate from UE#1.

6. P-CSCF#1 forwards the 200-OK final registration response to UE#1.

7. UE#1 initiates a new multi-media session, by sending an INVITE request to P-CSCF#1. This INVITE request includes the subscriber-identity URL used in the registration, and a caller-name string that may identify the specific person using the UE.

8. P-CSCF#1 checks the subscriber's identifying URL, and replaces it (or rejects the request) if it is incorrect.

9. P-CSCF#1 forwards the INVITE request, with the verified subscriber identity URL, to S-CSCF#1.

10. S-CSCF#1 verifies the caller-name string provided by UE#1 is included in the set of valid caller-names for this subscriber. It replaces it (or rejects the request) if it is incorrect.

11. S-CSCF#1 forwards the INVITE request, with verified subscriber identity URL and caller-name, to S-CSCF#2.

12. S-CSCF#2 stores the originating subscriber identity, for possible use later in call-trace or return-call services.

13. S-CSCF#2 forwards the INVITE request to P-CSCF#2.

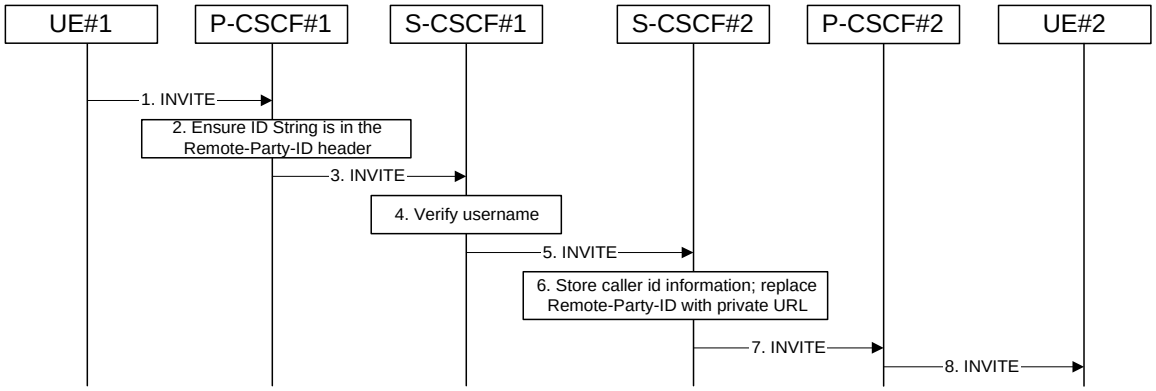
14. P-CSCF#2 forwards the INVITE request to UE#2.

15. UE#2 displays the caller-id and calling-name information to the called party.

5.12.X.2 Procedures for Caller-ID Blocking

Regulatory agencies, as well as subscribers, may require the ability of an originator to block the display of their caller identification. This is a function performed by the destination S-CSCF. In this way, the destination subscriber is still able to do a call-return, call-trace, transfer, or any other supplementary service.

The identity of the originator is stored at S-CSCF#2, and S-CSCF#2 generates a private URL that can be passed to UE#2 without compromising the identity of the call originator.



The detailed procedure is as follows:

1. UE#1 initiates a new multi-media session, by sending an INVITE request to P-CSCF#1. This INVITE request includes the subscriber-identity URL used in the registration, and a caller-name string that may identify the specific person using the UE. Also included in this INVITE message is a request that the caller-identity not be revealed to the destination.

2. P-CSCF#1 checks the subscriber's identifying URL, and replaces it (or rejects the request) if it is incorrect.

3. P-CSCF#1 forwards the INVITE request, with the verified subscriber identity URL, to S-CSCF#1.

4. S-CSCF#1 verifies the caller-name string provided by UE#1 is included in the set of valid caller-names for this subscriber. It replaces it (or rejects the request) if it is incorrect. Based on the subscriber's profile, S-CSCF#1 may insert a request in the INVITE message that the caller-identity not be revealed to the destination.

5. S-CSCF#1 forwards the INVITE request, with verified subscriber identity URL and caller-name, to S-CSCF#2.

6. S-CSCF#2 stores the originating subscriber identity, for possible use later in call-trace or return-call services. If caller-id blocking is requested, it replaces the caller-id with a private URL pointing to the stored information. If caller-name blocking is requested, it deletes the calling-name from the INVITE message.

7. S-CSCF#2 forwards the INVITE request to P-CSCF#2.

8. P-CSCF#2 forwards the INVITE request to UE#2.

Annex <F> (informative): Change history

Change history				
Date	**TSG #**	**TSG Doc.**	**Rev**	**Subject/Comment**
2000-07	SA-2	23.228	0.0.1	Initial version of the specification
2000-08			0.0.2	Editorial revisions based on email review
2000-09			0.1.0	Incorporated changes from the following contributions approved by the August 16-18, 2000 meeting in Vancouver (and subsequent email approval): S2-001310, S2-001311, S2-001313, S2-001314, S2-001315, S2-001316, and S2-001322.
2000-09			1.0.0	Incorporated changes from the following contributions approved by the September 4-8, 2000 meeting in Bristol: S2-001316, S2-001484, S2-001540, S2-001548, S2-001602, S2-001605, S2-001618, S2-001619, S2-001633, and S2-001635. Also incorporated the following contributions approved by email: S2-001399 and S2-001636R2.
2000-10			1.1.0	This version incorporates changes from the following contribution approved via email subsequent to the Bristol meeting but following the production of Version 1.0.0: S2-001483. This version also incorporates changes from the following contributions approved by the October 9-12 meeting in Sophia Antipolis: S2-001719, S2-001723, S2-001727, S2-001741, S2-001757, S2-001761, S2-001762, S2-001764, S2-001765, S2-001766, S2-001767, S2-001768, S2-001773, S2-001775, S2-001780, and S2-001782.
2000-10			1.2.0	This version incorporates changes to Figures 4.1 and 4.2 contained in S2-001548 approved in Bristol but inadvertently missed in the editing of Version 1.0.0. This also incorporates changes from contribution S2-001755 approved by the October 9-12 meeting in Sophia Antipolis, which was missed in the previous version.
2000-11			1.3.0	This version incorporates changes contained in S2-001776 approved by email subsequent to the October 9-12 meeting in Sophia Anitpolis meeting.
2000-11			1.4.0	This version incorporates changes from the following contributions approved by the November 13-17, 2000 meeting in Makuhari Japan: S2-001872, S2-001875, S2-001876, S2-001881, S2-001897, S2-001910, S2-002016, S2-002039, and S2-002040. This version also incorporates changes from S2-001777 approved by email subsequent to Sophia Antipolis but inadvertently missed in the editing of Version 1.3.0.