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# 3G TS 23.228 V1.0.0 (2000-09)

## 3<sup>rd</sup> Generation Partnership Project;
## Technical Specification Group Services and System Aspects;
## IP Multimedia (IM) Subsystem - Stage 2
## (3G TS 23.228 version 1.0.0)

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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;

        2   presented to TSG for approval;

        3   or greater indicates TSG approved document under change control.

    y   the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

    z   the third digit is incremented when editorial only changes have been incorporated in the document.

# 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 Autoconfiguration".

# 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.

## 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

## 4.2.3 Home and Visited Service Control

### 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
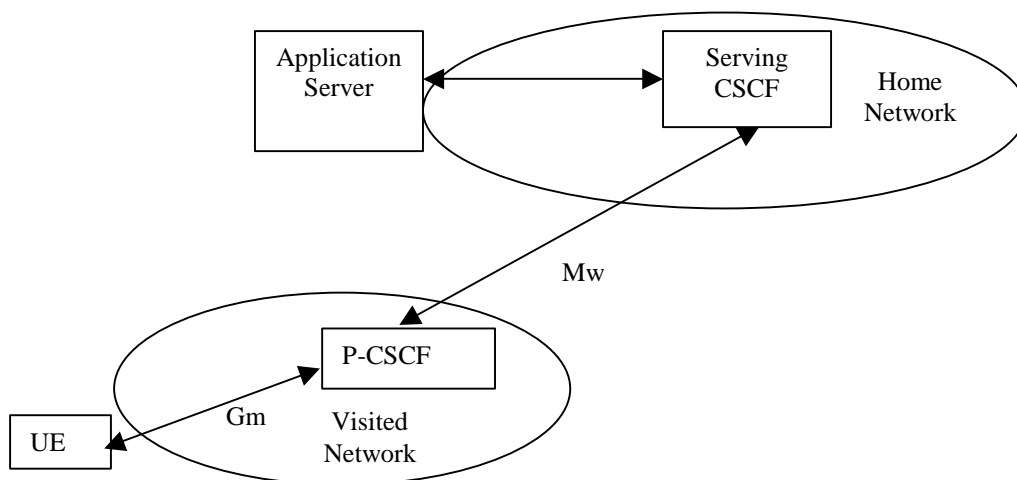


**Figure 4-1: Support of a UE via Serving CSCF in Home Network**

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)

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
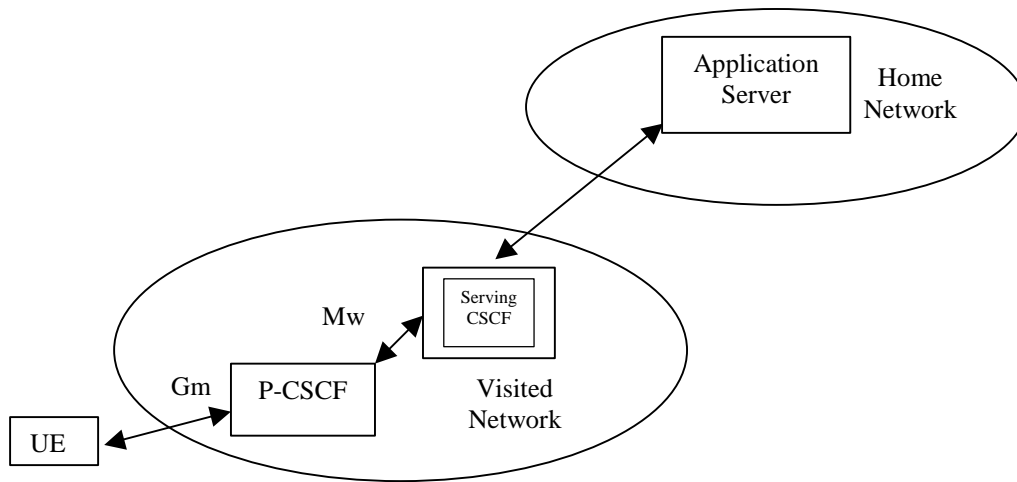


**Figure 4-2: Support of the UE via Serving CSCF in the Visited Network**

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 3<sup>rd</sup> party service 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.

## 4.2.3.1.3          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.

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

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

## 4.3    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 UMTS network may be implemented as a number logically separate IP networks which contain different parts of
the overall system. In this discussion each of these elements is referred to as an "IP Addressing Domain". Within an "IP
Addressing Domain" it is required that the nodes within the domain are part of a consistent non-overlapping IP-address
space. It is also required that IP packets may be routed from any node in the domain to any other node in the domain
using conventional IP routing. In a real implementation an IP Addressing Domain may be a physically separate IP
network or an IP VPN.

IP Addressing Domains may be interconnected at various points. At these points of interconnect gateways, firewalls or
NATs may be present. It is not guaranteed that IP packets from one IP Addressing Domain can be directly routed to any
interconnected IP Addressing Domain. Rather inter-Domain traffic will be handled via firewalls or tunnels. This implies
that different IP Addressing Domains can have different (and possibly overlapping) address spaces.

Figure 4-3 below shows the IP Addressing Domains involved in PS-domain and IP-subsystem services.
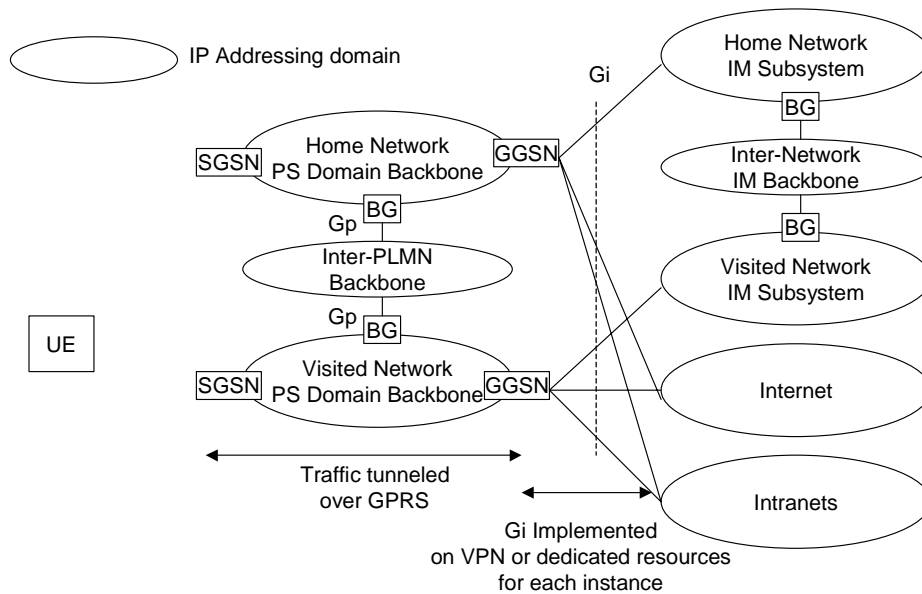
**Figure 4-3 – IP Addressing Domains Involved In PS-Domain and IM Services**

Though UMTS permits the possibility of using different IP Addressing Domains as shown above it is possible that several different IP Addressing Domains fall under a common co-operative management regime. In this case the different IP Addressing Domains may be physically implemented as a single domain at the operator's choice.

## 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:
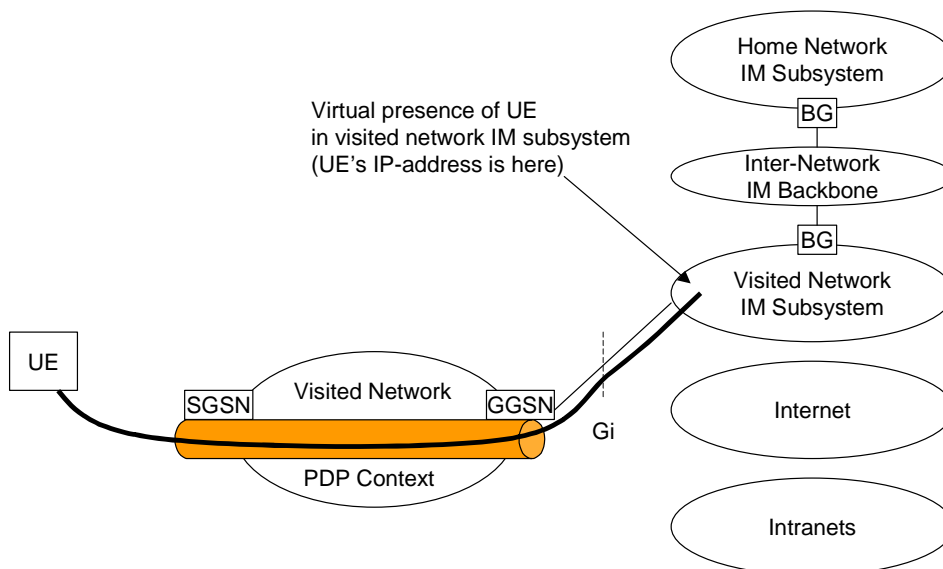


**Figure 4-4  UE Accessing IM Subsystem Services in the visited network**

### 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.

# 5        IP Multimedia Subsystem Procedures

<span style="color:red">Editor's note: this chapter discusses procedures specific to the IM Subsystem</span>

## 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 immediately after the first PDP context activation, following GPRS attach. These procedures shall 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.

### 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

<span style="color:red">Editor's Note: This is for further study.</span>

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 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 or 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.
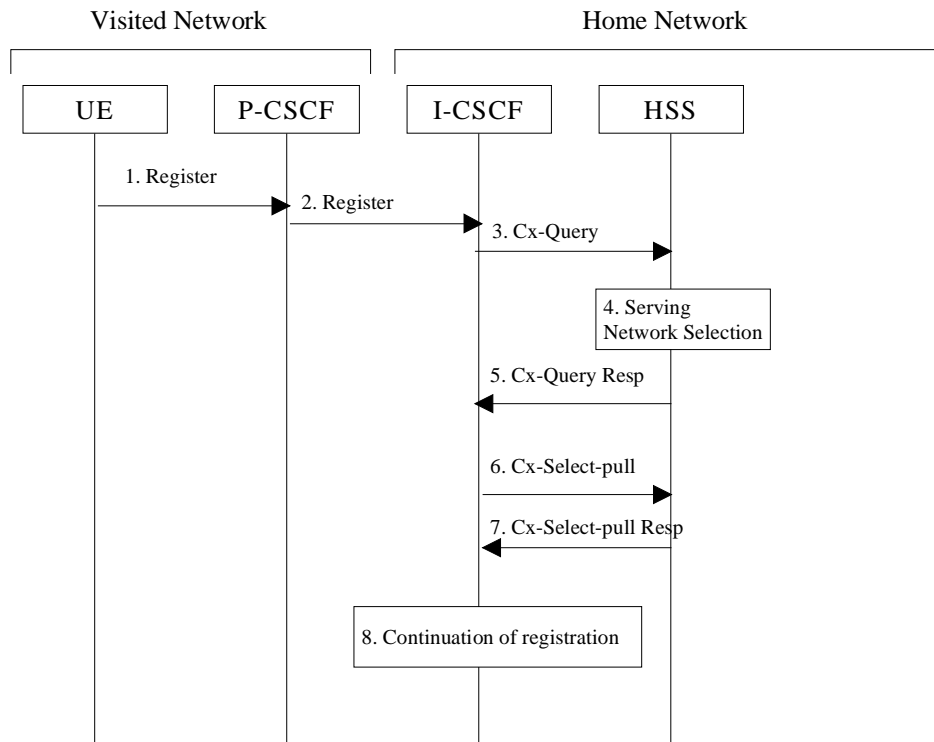
**Figure 5-1 Start of Registration – User not registered**

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, visited network capabilities, 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 capabilities, 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 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.

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 capbilities) 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, visited network capabilities, 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 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 (subscriber profile) to the S-CSCF. The S-CSCF shall store the subscriber profile for that indicated user.

7. The S-CSCF shall determine whether the home contact name is the S-CSCF name or the hI-CSCF name. 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.
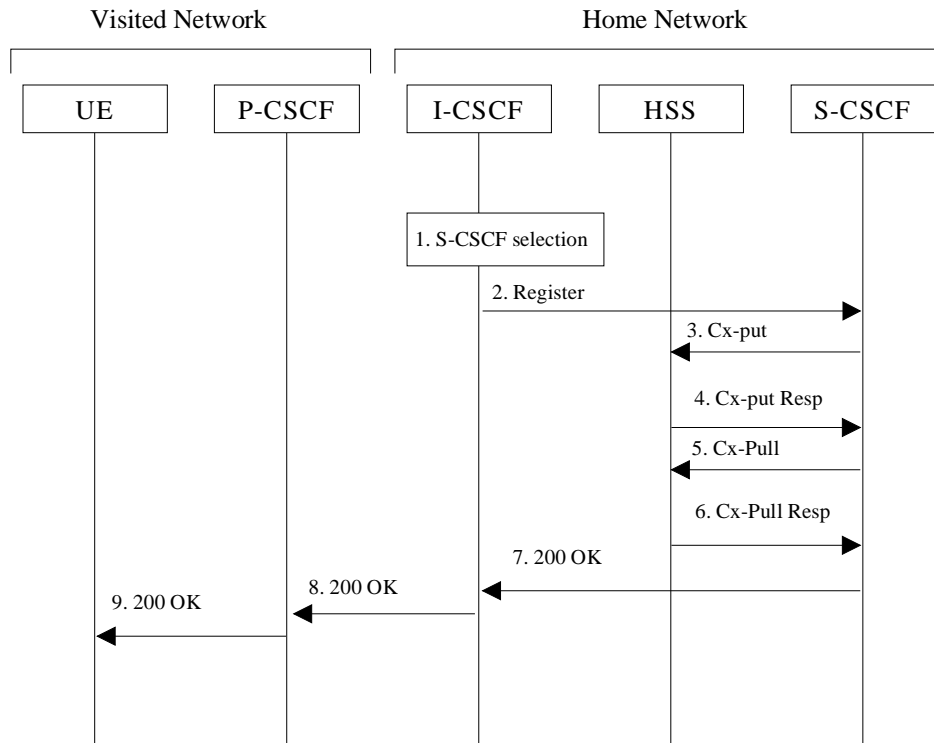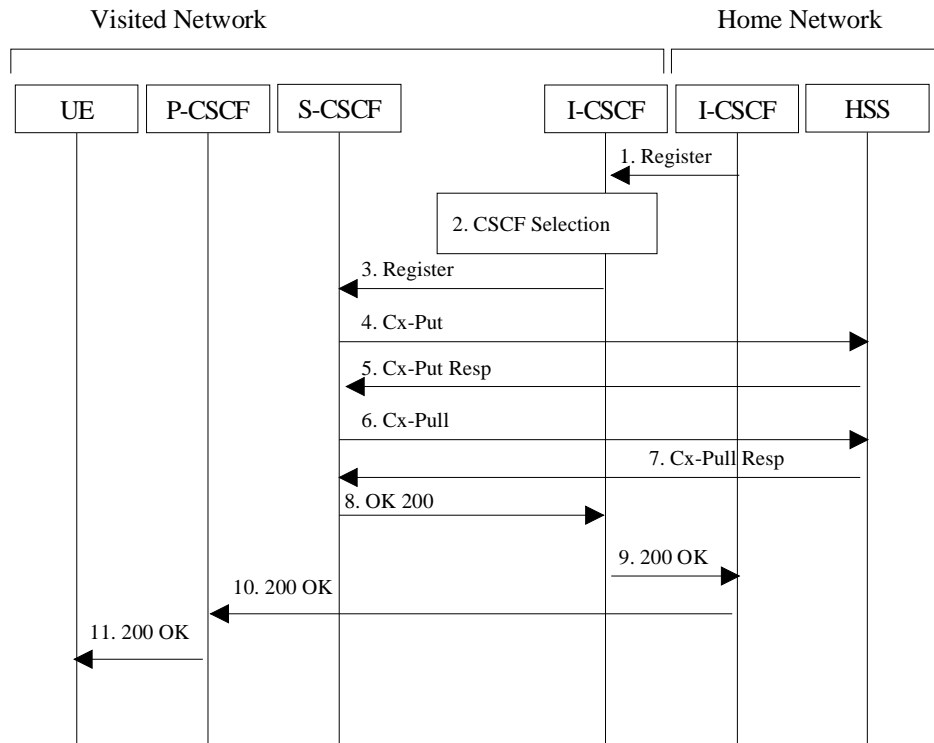


**Figure 5-3 Continuation of Registration - serving CSCF in visited network**

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 mechanismand then shall send the register information flow (P-CSCFs "name" in the contact header, visited network capabilities, 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 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 (subscriber profile) to the S-CSCF.  The S-CSCF shall store the subscriber profile 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<br>Home Domain | | Credentials<br>Home Domain<br>Proxy Name/Address |
| Proxy CSCF<br>- in local network | Routing Function<br>Local Network capabilities<br>) | Network Entry point<br>UE Address<br>(Editors Note: *Supplies potential list of Visited Serving CSCFs is FFS*) | Network Entry point<br>UE Address |
| Interrogating CSCF - in Home network | HSS Address | Serving CSCF address/name<br>(Editors Note: Access to Potential list of Serving CSCFs is FFS) | No State Information |
| Interrogating CSCF (visited)<br>- in visited network | HSS  Address | Serving CSCF (visited)<br>(Editors Note: Access to Potential list of serving CSCFs Is FFS) | No State Information |
| HSS | User Service Profile | (Editors Note: Local network capabilities?) | Serving CSCF address/name<br>Proxy address/name? |
| Serving CSCF (Home) | No state information | HSS Address/name<br>Subscriber profile<br>(limited – as per network scenario)<br>Proxy address/name | May have call state Information<br>HSS Address/name<br>Subscriber information<br>Proxy address/name |
| Serving CSCF (visited) | Local Service information<br>No state information | HSS (Home) Address/name<br>Subscriber profile<br>(Limited – as per operator agreement)<br>Proxy address/name | May have state Information<br>HSS (home) Address/name<br>Subscriber information<br>(limited - as per operator agreement)<br>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 Deregistration

## 5.4.2    Network Initiated Deregistration

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 mechansim 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.

## 5.6       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      Call Clearing Procedures

## 5.11      Supplementary Services Procedures

# 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.*
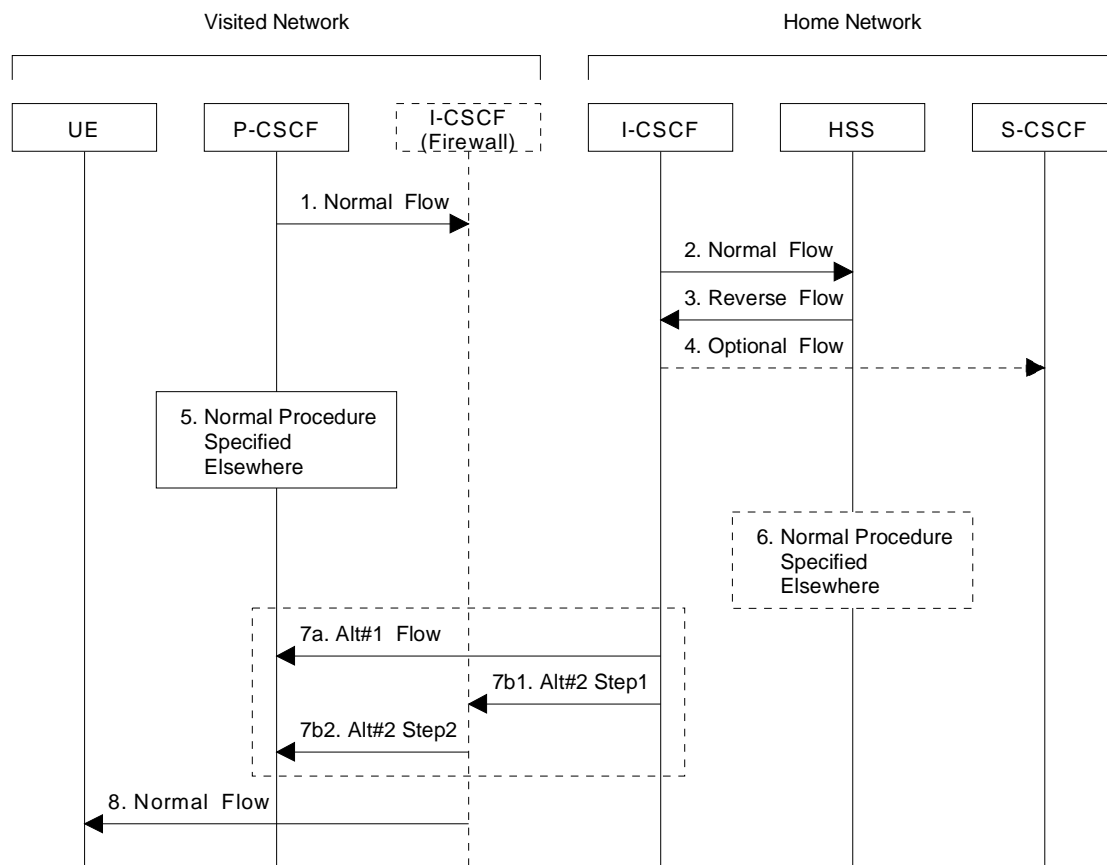


**Figure X.V Information Flow Template**

*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):
# Call Flow Procedures

# B.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.
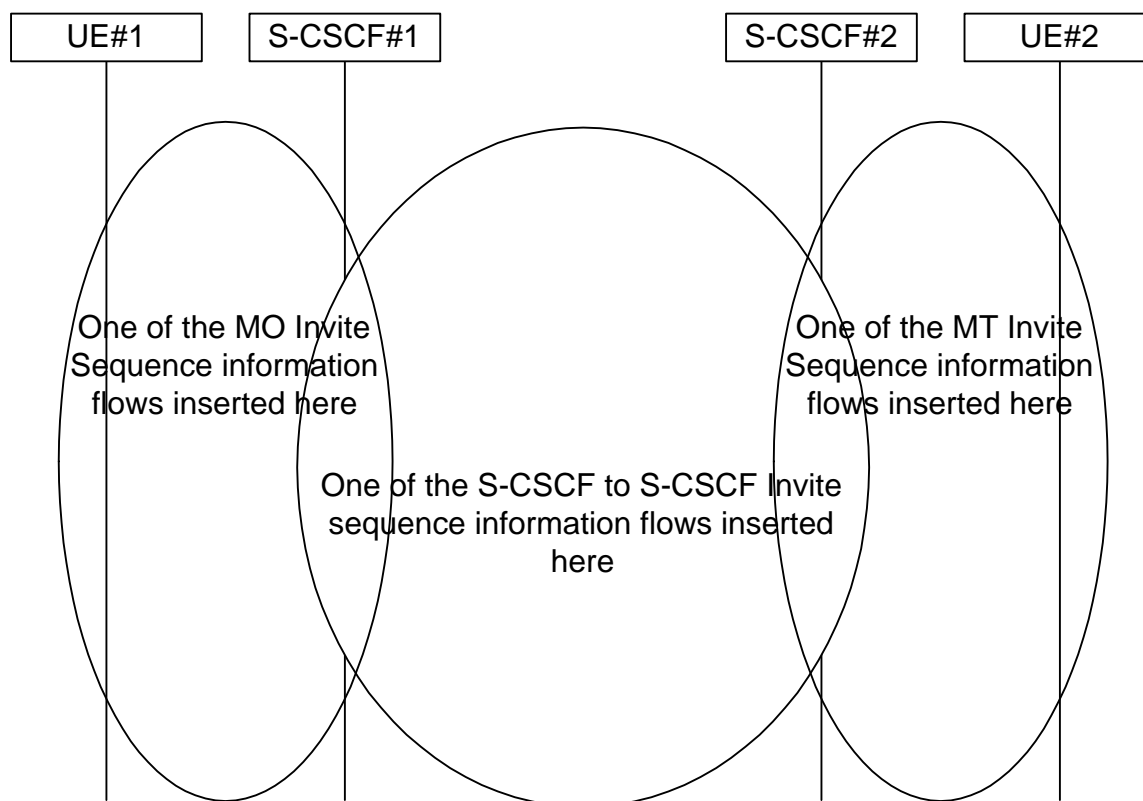


**Figure 1: Overview of Call Flow Sections**

The following procedures are defined:

- For the origination sequence:

  - (MO#1) Mobile origination, roaming, home control of services, with network configuration hidden by operator

  - (MO#2) Mobile origination, roaming, home control of services, without network configuration hidden by operator

  - (MO#3) Mobile origination, roaming, with visited network control of services

  - (MO#4) 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, with network configuration hidden by operator

  - (MT#2) Mobile termination, roaming, home control of services, without network configuration hidden by operator

  - (MT#3) Mobile termination, roaming, with visited network control of services

  - (MT#4) 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 termination either roaming with home control, non-roaming, or PSTN.

    - (S-S#2) Call origination and termination are served by different network operators, termination is done by visited network control, with network configuration hidden by operator.

    - (S-S#3) Call origination and termination are served by different network operators, termination is done by visited network control, without network configuration hidden by operator.

    - (S-S#4) Call origination and termination are served by the same operator.

    - (S-S#5) Call origination and termination are served by the same operator, termination is done by visited network control, with network configuration hidden by operator.

    - (S-S#6) Call origination and termination are served by the same operator, termination is done by visited network control, without network configuration hidden by operator.

    - (S-S#7) Call origination and termination are served by the same network operator, and performed by the same Serving-CSCF.  There are no messages exchanged, and no diagram is provided for this degenerate case.

The following call flows are defined by these procedures:

1.  Mobile origination, roaming, with home control, mobile termination, roaming, with home control, originating and terminating subscribers served by different network operators, with network operators hiding their network configuration.

    This call flow is constructed by combining the following procedures:

    - (MO#1) Mobile origination, roaming, home control, with configuration hiding

    - (S-S#1) Different network operators

    - (MT#1) Mobile termination, roaming, home control, with configuration hiding.

    An informative example of this call flow is given in Annex <Y1>.

2.  Mobile origination, roaming, with home control, mobile termination, roaming, with home control, originating and terminating subscribers served by different network operators, without network operators hiding their network configuration.

    This call flow is constructed by combining the following procedures:

    - (MO#2) Mobile origination, roaming, home control, without configuration hiding

    - (S-S#1) Different network operators

    - (MT#2) Mobile termination, roaming, home control, without configuration hiding.

3.  Mobile origination, roaming, with home control, mobile termination, roaming, with home control, originating and terminating subscribers served by different network operators, with originating network operator hiding their network configuration.

    This call flow is constructed by combining the following procedures:

    - (MO#1) Mobile origination, roaming, home control, with configuration hiding

    - (S-S#1) Different network operators

    - (MT#2) Mobile termination, roaming, home control, without configuration hiding.

4.  Mobile origination, roaming, with home control, mobile termination, roaming, with home control, originating and terminating subscribers served by different network operators, with terminating network operator hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#1) Different network operators

- (MT#1) Mobile termination, roaming, home control, with configuration hiding.

5.   Mobile origination, roaming, with home control, mobile termination, roaming, with home control, originating and terminating subscribers served by the same network operator, with network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#1) Mobile origination, roaming, home control, with configuration hiding

- (S-S#4) Single network operator

- (MT#1) Mobile termination, roaming, home control, with configuration hiding.

6.   Mobile origination, roaming, with home control, mobile termination, roaming, with home control, originating and terminating subscribers served by the same network operator, without network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#4) Single network operator

- (MT#2) Mobile termination, roaming, home control, without configuration hiding.

7.   Mobile origination, roaming, with home control, mobile termination, roaming, with home control, originating and terminating subscribers served by the same network operator, with originating network operator hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#1) Mobile origination, roaming, home control, with configuration hiding

- (S-S#4) Single network operator

- (MT#2) Mobile termination, roaming, home control, without configuration hiding.

8.   Mobile origination, roaming, with home control, mobile termination, roaming, with home control, originating and terminating subscribers served by the same network operator, with terminating network operator hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#4) Single network operator

- (MT#1) Mobile termination, roaming, home control, with configuration hiding.

9.   Mobile origination, roaming, with home control, PSTN termination at the home network, with network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#1) Mobile origination, roaming, home control, with configuration hiding

- (S-S#4) Single network operator

- (PSTN-T) PSTN termination

10. Mobile origination, roaming, with home control, PSTN termination at the home network, without network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#4) Single network operator

- (PSTN-T) PSTN termination

11. Mobile origination, roaming, with home control, mobile termination, roaming, with visited control, originating and terminating subscribers served by different network operators, with network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#1) Mobile origination, roaming, home control, with configuration hiding

- (S-S#2) Different network operators, visited network termination, with configuration hiding

- (MT#3) Mobile termination, roaming, visited control.

An informative example of this call flow is given in Annex Y.

12. Mobile origination, roaming, with home control, mobile termination, roaming, with visited control, originating and terminating subscribers served by different network operators, without network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#3) Different network operators, visited network termination, without configuration hiding

- (MT#3) Mobile termination, roaming, visited control.

13. Mobile origination, roaming, with home control, mobile termination, roaming, with visited control, originating and terminating subscribers served by different network operators, with originating network operator hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#1) Mobile origination, roaming, home control, with configuration hiding

- (S-S#3) Different network operators, visited network termination, without configuration hiding

- (MT#3) Mobile termination, roaming, visited control.

14. Mobile origination, roaming, with home control, mobile termination, roaming, with visited control, originating and terminating subscribers served by different network operators, with terminating network operator hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#2) Different network operators, visited network termination, with configuration hiding

- (MT#3) Mobile termination, roaming, visited control.

15. Mobile origination, roaming, with home control, mobile termination, roaming, with visited control, originating and terminating subscribers served by the same network operator, with network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#1) Mobile origination, roaming, home control, with configuration hiding

- (S-S#5) Single network operator, visited network termination, with configuration hiding

- (MT#3) Mobile termination, roaming, visited control.

16. Mobile origination, roaming, with home control, mobile termination, roaming, with visited control, originating and terminating subscribers served by the same network operator, without network operators hiding their network configuration.

 This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#6) Single network operator, visited network termination, without configuration hiding

- (MT#3) Mobile termination, roaming, visited control.

17. Mobile origination, roaming, with home control, mobile termination, roaming, with visited control, originating and terminating subscribers served by the same network operator, with originating network operator hiding their network configuration.

 This call flow is constructed by combining the following procedures:

- (MO#1) Mobile origination, roaming, home control, with configuration hiding

- (S-S#6) Single network operator, visited network termination, without configuration hiding

- (MT#3) Mobile termination, roaming, visited control.

18. Mobile origination, roaming, with home control, mobile termination, roaming, with visited control, originating and terminating subscribers served by the same network operator, with terminating network operator hiding their network configuration.

 This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#5) Single network operator, visited network termination, with configuration hiding

- (MT#3) Mobile termination, roaming, visited control.

19. Mobile origination, roaming, with home control, PSTN termination at the visited network, with network operators hiding their network configuration.

 This call flow is constructed by combining the following procedures:

- (MO#1) Mobile origination, roaming, home control, with configuration hiding

- (S-S#5) Single network operator, visited termination, with configuration hiding

- (PSTN-T) PSTN termination

20. Mobile origination, roaming, with home control, PSTN termination at the visited network, without network operators hiding their network configuration.

 This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#6) Single network operator, visited termination, without configuration hiding

- (PSTN-T) PSTN termination

21. Mobile origination, roaming, with home control, mobile termination, home, originating and terminating subscribers served by different network operators, with network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#1) Mobile origination, roaming, home control, with configuration hiding

- (S-S#1) Different network operators

- (MT#4) Mobile termination, home.

An informative example of this call flow is given in Annex Y.

22.  Mobile origination, roaming, with home control, mobile termination, home, originating and terminating subscribers served by different network operators, without network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#1) Different network operators

- (MT#4) Mobile termination, home.

23.  Mobile origination, roaming, with home control, mobile termination, home, originating and terminating subscribers served by the same network operator, with network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#1) Mobile origination, roaming, home control, with configuration hiding

- (S-S#4) Single network operator

- (MT#4) Mobile termination, home.

An informative example of this call flow is given in Annex Y.

24.  Mobile origination, roaming, with home control, mobile termination, home, originating and terminating subscribers served by the same network operator, without network operators hiding their network configuration.

This call flow is constructed by combining the following procedures:

- (MO#2) Mobile origination, roaming, home control, without configuration hiding

- (S-S#4) Single network operator

- (MT#4) Mobile termination, home.

In a similar manner, cases 25-48 are for mobile origination, roaming, with visited network control.  Cases 49-96 are for mobile origination, home.  Cases 97-120 are for PSTN origination.

# B.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.

# B.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 labeled 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 labeled S-CSCF#2 and UE#2 are combined into the single MGCF of the PSTN-T procedure.
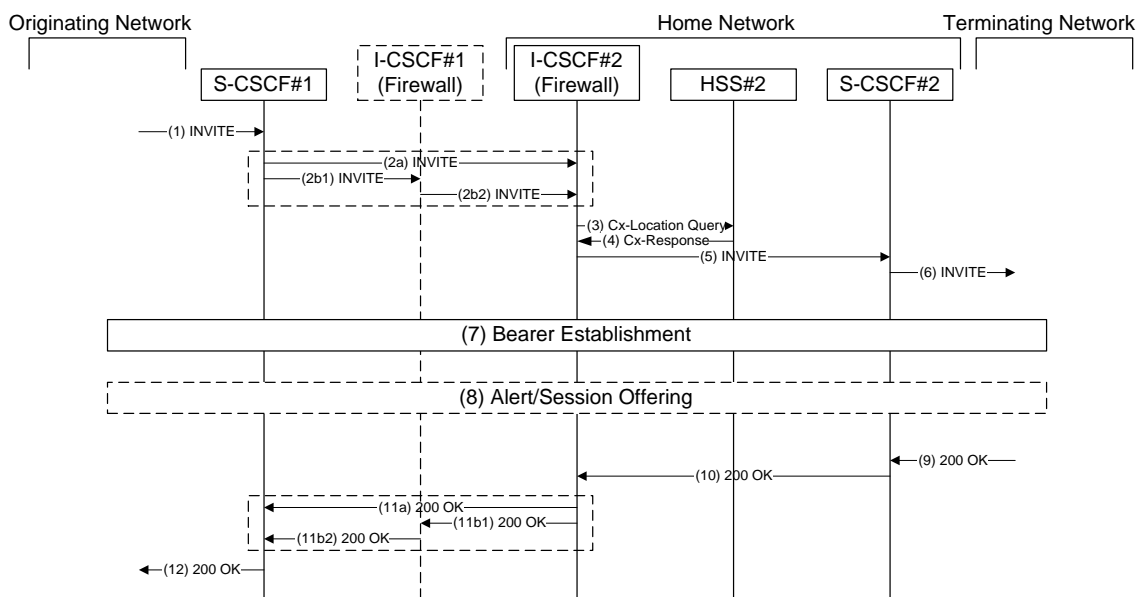
Procedure S-S#1 is as follows:

(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 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)).

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

    (2b)      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.

        (2b1)  The INVITE request is sent from S-CSCF#1 to I-CSCF#1

        (2b2)  I-CSCF#1 performs the configuration-hiding modifications to the request and       forwards it to I-CSCF#2

(3)      I-CSCF (at the border of the terminating subscriber's network) queries the HSS for current location information.

(4)      HSS responds with the address of the current Serving-CSCF for the terminating subscriber.

(5)      I-CSCF forwards the INVITE request to the S-CSCF that will handle the call termination.

(6)      The sequence continues with the message flows determined by the termination procedure.

(7)      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

(8)      The alerting phase, if required, which may require additional SIP messages to carry the indication from the called party back to the calling party

(9)-(12) 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.

# B.2.2 (S-S#2) Different network operators performing origination and termination, visited network control of termination.

This section to be supplied from future contributions.

# B.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 labeled 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.
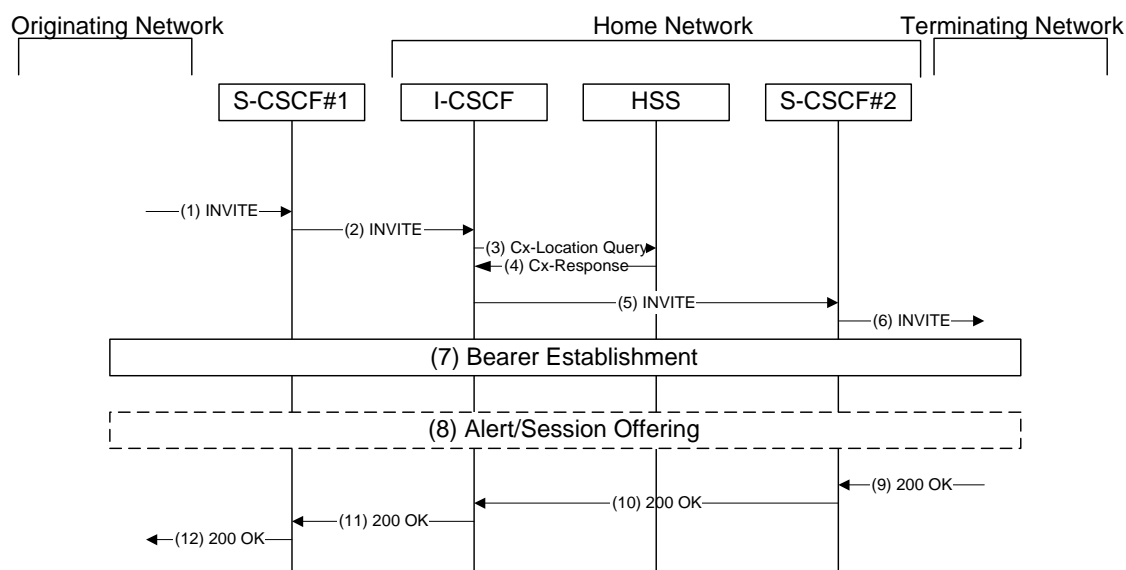
PSTN-T PSTN termination. The "Terminating Network" of S-S#3 is the home network. The elements labeled S-CSCF#2 and UE#2 are combined into the single MGCF of the PSTN-T procedure.



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 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.

(3)      I-CSCF queries the HSS for current location information.

(4)      HSS responds with the address of the current Serving-CSCF for the terminating subscriber.

(5)      I-CSCF forwards the INVITE request to the S-CSCF that will handle the call termination.

(6)      The sequence continues with the message flows determined by the termination procedure.

(7)      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

(8)      The alerting phase, if required, which may require additional SIP messages to carry the indication from the called party back to the calling party

(9)-(12) 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.

## B.2.4    (S-S#4) Call origination and termination are served by the same operator, termination is done by visited network control.

This section to be supplied from future contributions.

# B.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.

## B.3.1    (MO#1) Mobile origination, roaming, with home control of services

This section to be supplied from future contributions.

# B.3.2    (MO#2) Mobile origination, roaming, with visited network control of services

This section to be supplied from future contributions.

# B.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.
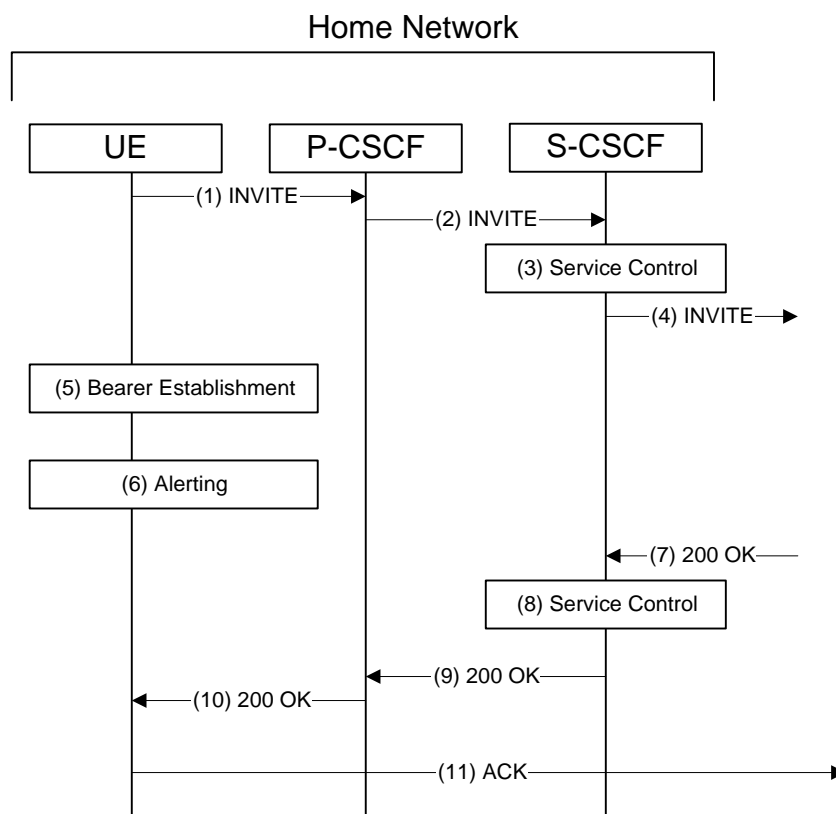


Procedure MO#4 is as follows:

(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)     UE#1 responds to the SIP final response with a ACK message

# B.3.4    (PSTN-O) PSTN origination (where the S-CSCF is a MGCF)

This section to be supplied from future contributions.

# B.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.

# B.4.1    (MT#1) Mobile termination, roaming, with home control of services

This section to be supplied from future contributions.

# B.4.2    (MT#2) Mobile termination, roaming, with visited network control of services

This section to be supplied from future contributions.

# B.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 a 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.
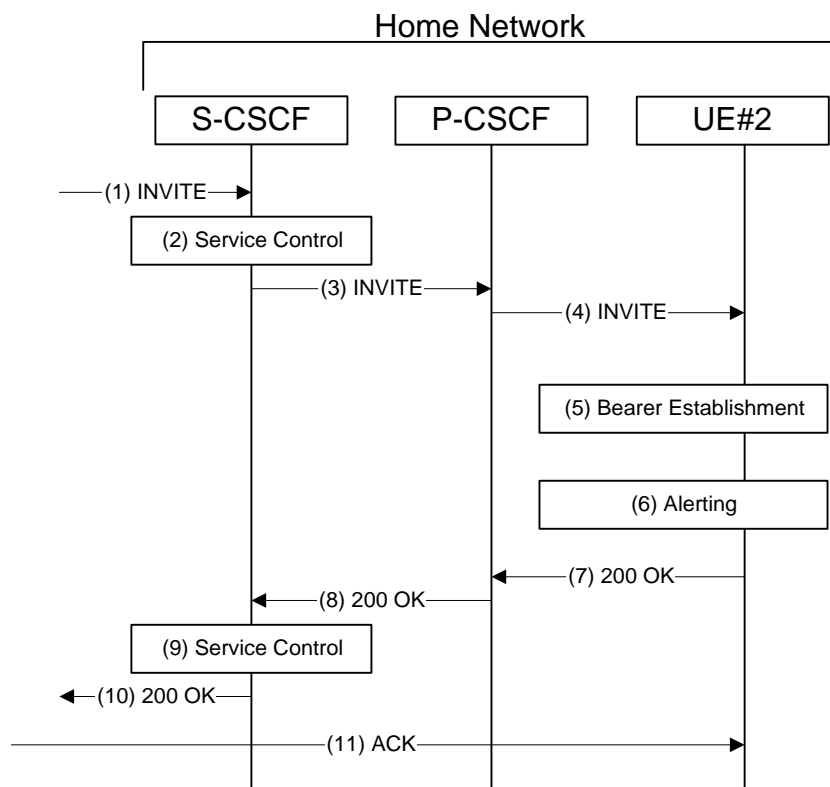


Procedure MT#3 is as follows:

(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)    The call originator responds to the 200-OK by sending the ACK message to UE#2.

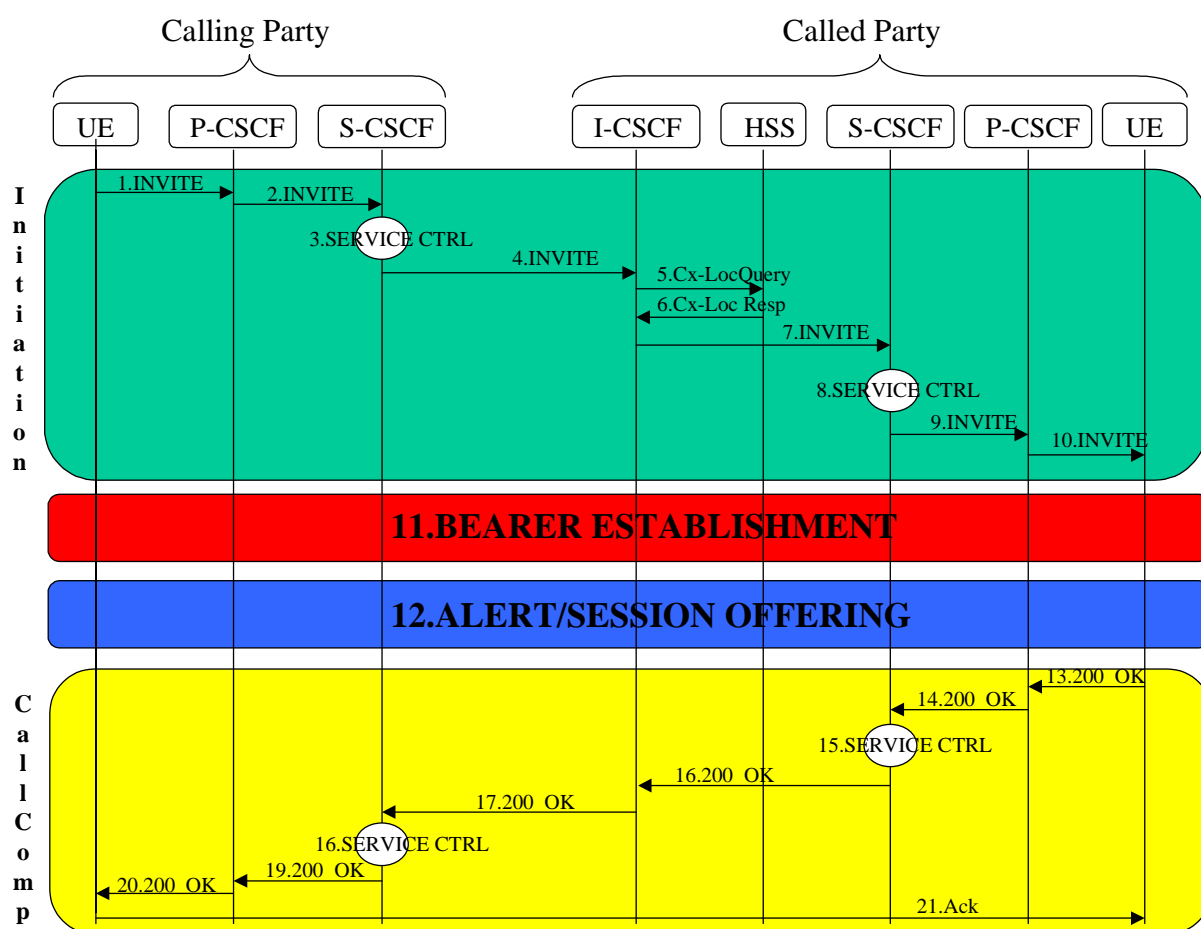# B.4.4    (PSTN-T) PSTN termination (where the S-CSCF is a MGCF)

This section to be supplied from future contributions.

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

## C.1    Sample end-end Call Flow - Mobile Origination/Termination

This informative annex contains a complete end-to-end call flow for a call with the properties  listed in C.1.3 Assumptions.

### C.1.1   Call Flow Diagram



**Initiation Process**

1. The   Ue   shall   send   a   INV   (session   destination)   to   the   P-CSCF. Note:  It is assumed that the address of the P-CSCF is obtained from the CSCF discover procedures.

2. The P-CSCF forward the INV (session destination) to the next hop name/address.  In this case the next hop address is the S-CSCF.

3. The S-CSCF can read the information on whom originated the INV, and forwarded this based on the session destination.

4.   The S-CSCF forwards the invite message to the ICSCF.

5.   The I-CSCF sends 'Cx-Location Query' to the HSS to obtain the identity of the of the next hop which in this case is the S-CSCF

6.   The HSS sends the 'Cx-Location Query Response' to the I-CSCF

7.   The I-CSCF forwards the INVITE message to the S-CSCF for the called party

8.   The S-CSCF carries out Service Control for Called Party

9.   The S-CSCF forwards the INVITE message to the P-CSCF (Called Party)

10.  The P-CSCF forwards the INVITE message to the UE (Called Party)


***Bearer Establishment Process***

11.  Bearer reservation (temp establishment) which will require a 183 to carry the bearer information of the called party back to the calling party (this is for further study)


***Alerting/Session Offering Process***

12.  (This is for further study)


***Call/Session Complete Process***

13.  The UE (Called Party) sends a 200 OK message to the P-CSCF (Called Party)

14.  The P-CSCF (Called Party) forwards the 200 OK message to the S-CSCF (Called Party)

15.  The S-CSCF carries out Service Control for the Called Party (Optional)

16.  The S-CSCF forwards the 200 OK message to the I-CSCF (Called Party)

17.  The I-CSCF (Called Party) forwards the 200 OK message to the S-CSCF (Calling Party)

18.  The S-CSCF (Calling Party) carries out Service Control for the Calling Party (Optional)

19.  The S-CSCF (Calling Party) forwards the 200 OK message to the P-CSCF (Calling Party)

20.  The P-CSCF (calling Party) forwards the 200 OK message to the UE (Calling Party)

21.  The UE (Calling Party) sends an Ack message to the UE (called Party)


***Release Process***

(not part of the establishment of the call and is for further study)


## C.1.2   Assumptions

No hiding issues have been considered in the flow

Both the Called Party and the Calling Party are registered

The Called Party wants to be reached in the IM domain

The Calling Party and the Called party are both served by the same network operator

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

Before the invite is sent from the UE it is assumed that

    1) The C Plane is already established

    2) The UE has knowledge of the Proxy Address

**Initiation Process**

1) Proxy sends Invite to S-CSCF

    1) The Proxy determines the next hop address which is this case is the  S-CSCF identity

2) Serving CSCF (actions of the CSCF)

    1) Have the ability to examine from whom the INVITE was sent (the calling party) and to

    3) Have the ability to determine the destination of the INVITE message

    2) The Service Control may be carried out by the S-CSCF

4) Serving CSCF sends Invite I-CSCF

    1) The S-CSCF determines the next hop address which in this

    case is the I-CSCF address. This operation may employ

    external (to the function) databases.

5) I-CSCF sends Cx-Location Query to HSS

  1) The I-CSCF has the ability to determine the address of the

    HSS

6) HSS sends Cx-Location Response to the I-CSCF

  1) No assumptions at this stage

7) I-CSCF forwards INVITE to S-CSCF of Called Party

  1) May involve DNS lookup to determine the S-CSCF address

8) Serving CSCF (Called Party) (actions of the CSCF)

    1) Have the ability to examine from whom the INVITE was sent (the calling party) and to

    3) Have the ability to determine the destination of the INVITE message

    2) The Service Control may be carried out by the S-CSCF

9) S-CSCF forwards INVITE to P-CSCF (Called Party)

    1)  The S-CSCF uses the P-CSCF identity for the Called Party

       that was discovered in the Registration process

    2)  The result of the Service Control is to forward the INVITE to

             the P-CSCF of the Called Party


10) P-CSCF (Called Party) forwards INVITE to UE (Called Party)

    1)  The P-CSCF uses the identity of the Called Party that was

         discovered in the registration process


***Bearer Establishment Process***

To be Completed


***Alert/Session Offering Process***

To be Completed


***Call/Session Complete Process***

13) UE (Called Party) sends 200 OK to P-CSCF (Called Party)

    1) No assumptions


14) Proxy (Called Party) forwards 200 OK to S-CSCF (Called Party)

    1) No assumptions


15) Serving CSCF (Called Party) (actions of the S-CSCF)

    1) The S-CSCF has the ability to carry out whatever service control is

       necessary


16) Serving CSCF (Called Party) forwards 200 OK to I-CSCF (Called Party)

    1) No assumptions


17) I-CSCF (Called Party) forwards 200 OK to S-CSCF (Calling Party)

    1) No assumptions


18) Serving CSCF (Calling Party) (actions of the S-CSCF)

1) The S-CSCF has the ability to carry out whatever service control is

   necessary

19) Serving CSCF (Calling Party) forwards 200 OK to P-CSCF (Calling Party)

   1) No assumptions

20) P-CSCF (Calling Party) forwards 200 OK to UE (Calling Party)

   1) No assumptions

21) UE (Calling Party) send Ack to UE (Called Party)

   1) No assumptions

**Release Process**

To be Completed

# C.1.3   Issues

General Issues
   1)            A U plane bearer may need to be established before the invite message is sent
                 from the UE. This is for further study.

   2)   Authentication of the INVITE message

   3)            Security

   4)            It may be possible that the alerting/session offering may occur before the
                 bearer setup phase

Proxy CSCF Calling Party
   1)            The extent of address translation performed in the proxy

S-CSCF

   1) The analysis of the destination address

   2) The analysis of the calling party address   (authentication,

               service selection etc)

I-CSCF to HSS

   1) The I-CSCF must be able to construct the Cx-Location

                  Query based on the called party identity

Alerting phase

1)            The alerting phase may be optional based on the service request and the
              timing of called party answering

UE (Ack) to UE

1)   There are concerns over the fact that the calling party would have

     knowledge of the Called Party address.

# C.2    Sample end-end Call Flow - PSTN Termination

This informative annex contains a complete end-to-end call flow for a call with the following properties:

- Mobile origination, roaming, visited control, with configuration hiding

- Different network operators

- PSTN termination.

This end-to-end call flow is informational only; any discrepancies with the normative call flow formed by the procedures are to be resolved in favor of the call flow procedures.

Further text to be supplied.

# Annex <D> (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.<br>Also incorporated the following contributions approved by email: S2-001399 and S2-001636R2. |
| | | | | |