3GPP TSG CN Plenary Meeting #19 **NP-030048**
12th - 14th March 2003. Birmingham, U.K.

Source: **TSG CN WG 1**

Title: **CR to Rel-5 on Work Item IMS-CCR towards 24.228(102r2)**

Agenda item: **8.1**

Document for: **APPROVAL**

Introduction:

This document contains **1** CR, **Rel-5 to** Work Item **"IMS-CCR"**, that have been agreed by **TSG CN WG1**, and are forwarded to TSG CN Plenary meeting #19 for approval.

N1-030283 is dependant on approval of CR#341r1 on 3GPP TS 24.229 in N1-030284 (NP-030052).

Spec	CR	Rev	Cat	Phase	Subject	Version-Current	Version-New	Meeting-2nd-Level	Doc-2nd-Level
24.228	102	2	F	Rel-5	General update to clauses 6 and 16	5.3.0	5.4.0	N1-28	N1-030283

3GPP TSG-CN1 Meeting #28 ***Tdoc N1-030283***
Dublin, Ireland, 10 – 14 February 2003 **rev. of N1-030190**

CR-Form-v7

CHANGE REQUEST

⌘ **24.228** **CR** **102** ⌘ **rev** **2** ⌘ Current version: **5.3.0** ⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: UICC apps⌘ [ ] ME [X] Radio Access Network [ ] Core Network [X]

Title:	⌘	General update to clauses 6 and 16
Source:	⌘	Nokia
Work item code:	⌘	IMS-CCR
Date:	⌘	03/02/2003
Category:	⌘	**F**
Release:	⌘	Rel-5

Use one of the following categories:
F *(correction)*
A *(corresponds to a correction in an earlier release)*
B *(addition of feature),*
C *(functional modification of feature)*
D *(editorial modification)*
Detailed explanations of the above categories can be found in 3GPP TR 21.900.

Use one of the following releases:

2	*(GSM Phase 2)*
R96	*(Release 1996)*
R97	*(Release 1997)*
R98	*(Release 1998)*
R99	*(Release 1999)*
Rel-4	*(Release 4)*
Rel-5	*(Release 5)*
Rel-6	*(Release 6)*

Reason for change:	⌘	The example flows shown in 24.228 are quite missaligned with the procedures specified in 24.229. The following aspects have been identified: • Header stripping • P-Access-Network-Info header is missing • comp=sigcomp parameter is not present in any flow • Port number used in IPsec not present in URIs and Via header values • Security-Verify header not present in subsequent requests, as mandated by RFC 3329 • There is no differentiation on MO/MT S-CSCF addresses required by 24.229 Additionally, text needs to be added related to the authorization of the SUBSCRIBE request.
Summary of change:	⌘	Corrections according to the reasons
Consequences if not approved:	⌘	24.228 is not aligned with 24.229

Clauses affected:	⌘	6, 16

Other specs affected: ⌘	Y	N		
		X	Other core specifications	⌘
		X	Test specifications	
		X	O&M Specifications	

Other comments: ⌘

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at http://www.3gpp.org/specs/CR.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ⌘ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://ftp.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

6 Signalling flows for REGISTER (non hiding)

6.1 Introduction

In IMS Authentication is performed at registration time. The following sections show examples of SIP registration and UMTS AKA authentication. It is possible for the home to require other types of authentication.

In the example below, Digest AKA is used within SIP headers to carry the information related to the authentication-challenge and response.

6.2 Registration signalling: user not registered

Figure 6.2-1 shows the registration signalling flow for the scenario when the user is not registered. For the purpose of this registration signalling flow, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network does not have network configuration hiding active.

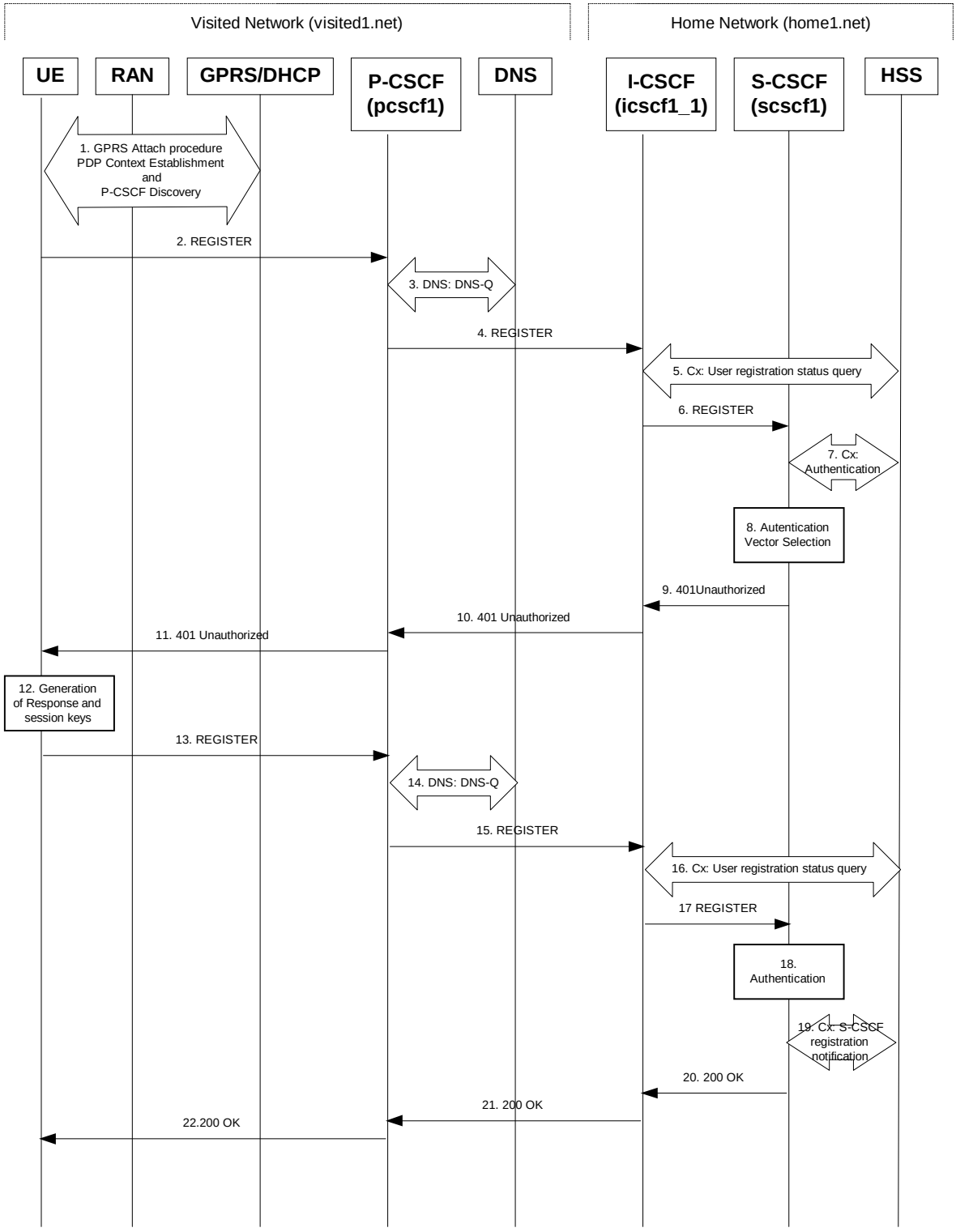

Figure 6.2-1: Registration signalling: user not registered

1. **GPRS Attach / PDP Context Establishment and P-CSCF Discovery (UE to GPRS)**

   This signalling flow is shown to indicate prerequisites for the registration signalling.

   See subclause 5.2 for details.

2. **REGISTER request (UE to P-CSCF) – see example in table 6.2-2**

The purpose of this request is to register the user's SIP URI with a S-CSCF in the home network. This request is routed to the P-CSCF because it is the only SIP server known to the UE. ~~In the following SIP request, the Contact field contains the user's host address.~~

The P-CSCF will perform two actions, binding and forwarding. The binding is between the u~~U~~ser's SIP URI~~address~~ (<sip:user1_public1@home1.net>) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which was acquired during PDP context activation process.

Table 6.2-2: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 70
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd];comp=sigcomp>;expires=7200
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce="", uri="sip:registrar.home1.net", response=""
Security-Client: ipsec-3gpp; alg=hmac-sha-1-96; spi=12345678; port1=1357
Require: sec-agree
Proxy-Require: sec-agree
CSeq: 1 REGISTER
Supported: path
Expires: 7200
Content-Length: 0
```

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("registrar.home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Via: IPv6 address of the ~~SIP session~~UE allocated during the PDP Context Activation process.

Max-Forwards: Set to 70 by the UE and used to prevent loops.

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates the public user identity being registered. This is the identity by which other parties know this subscriber. It may be obtained from the USIM.

Contact: This indicates the point-of-presence for the subscriber - the IP address of the UE. This is the temporary point of contact for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and S-CSCF.

Authorization: It carries authentication information. The private user identity (user1_private@home1.net) is carried in theusername field of the Digest AKA protocol. The uri parameter (directive) contains the same value as the Request-URI. The realm parameter (directive) contains the network name where the username is authenticated. The Request-URI and the realm parameter (directive) value are obtained from the same field in the USIM and therefore, are identical. In this example, it is assumed that a new UICC card was just inserted into the terminal, and there is no other cached information to send. Therefore, nonce and response parameters (directives) are empty.

Security-Client: ~~l~~Lists the supported algorithm(s) by the UE.

Supported: This header is included to indicate to the recipient that the UE supports the Path header.

P-Access-Network-Info: the UE provides the access-type and access-info, related to the serving access network as specified in sub-clause ' Additional coding rules for P-Access-Network-Info header', in 3GPP TS 24.229 [16].

Upon receiving this request the P-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

3. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs the DNS queries to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port number are not indicated, the P-CSCF performs an NAPTR query for the domain specified in the Request-URI.

Table 6.2-3a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [14].

Table 6.2-3b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net          0 IN NAPTR 50   50 "s" "SIP+D2U"    ""
     _sip._udp.registrar.home1.net
                    0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                          0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""
     _sips._tcp.registrar.home1.net
```

Based on the order and preference of the NAPTR record and the local preference, UDP is preferred and the P-CSCF finds the I-CSCF by a DNS SRV lookup according to RFC 2782 [4].

Table 6.2-3c: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.2-3d: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                     0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

4. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-4**

The P-CSCF needs to be in the path for ~~all mobile originated and~~ all mobile terminated requests for this user. To ensure this, the P-CSCF adds itself to the Path header value for future requests.

The P-CSCF binds the public user identity under registration to the Contact header supplied by the user.

The P-CSCF adds also the P-Visited-Network-ID header with the contents of the identifier of the P-CSCF network. This may be the visited network domain name or any other identifier that identifies the visited network at the home network.

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

P-CSCF removes the Security-Client and Require: sec-agree headers prior to forwarding the message.

Table 6.2-4: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 69
P-Access-Network-Info:
Path: <sip:term@pcscf1.visited1.net;lr>
Require: path
P-Visited-Network-ID: "Visited Network Number 1"
P-Charging-Vector: icid-value=a834bc192fe3; icid-generated-at=[5555::e9e:d8d:c7c:b6b]
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce="", uri="sip:registrar.home1.net", response="", integrity-protected="no"
CSeq:
Supported:
~~Expires:~~
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF where to route terminating requests~~sessions~~.

Require: This header is included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

P-Visited-Network-ID: It contains the identifier of the P-CSCF network at the home network.

P-Access-Network-Info: this header contains information from the UE.

P-Charging-Vector: The P-CSCF inserts this header and populates the icid parameters with a unique value and the IP address of the P-CSCF.

5. **Cx: User registration status query procedure**

The I-CSCF makes a request for information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-5a provides the parameters in the REGISTER request (flow 4) which are sent to the HSS.

Table 6.2-5a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	P-Visited-Network-ID:	This information indicates the network identifier of the visited network

6. **REGISTER request (I-CSCF to S-CSCF) – see example in table 6.2-6**

I-CSCF does not modify the Path header.

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.2-6: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 68
P-Access-Network-Info:
Path:
Require:
P-Visited-Network-ID:
P-Charging-Vector:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Supported:
~~Expires:~~
Content-Length:
```

Path: The S-CSCF stores the contents of the Path header and uses the URI ~~for routing mobile terminated sessions~~for routing mobile terminated requests.

Upon receiving this request the S-CSCF may set its SIP registration timer for this UE to the Expires time in this request or the S-CSCF may assign another registration timer for this registration

7. **Cx: Authentication procedure**

As the REGISTER request arrived without integrity protection to the P-CSCF, the S-CSCF shall challenge it. For this, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

The S-CSCF indicates to the HSS that it has been assigned to serve this user.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-7a provides the parameters in the REGISTER request (flow 6) which are sent to the HSS.

Table 6.2-7a Cx: S-CSCF authentication information procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	S-CSCF Name	Request-URI:	This information element contains the name of the S-CSCF. The presence of this IE indicates that the user has not been authenticated yet by the S-CSCF

8. **Authentication vector selection**

   The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 1: The authentication vector may be of the form as in 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

- $AV = RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:
  - RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
  - AUTN: Authentication token (including MAC and SQN).
  - XRES: Expected (correct) result from the UE.
  - CK: Cipher key (optional).
  - IK: Integrity key.

9. **401 Unauthorized response (S-CSCF to I-CSCF) - see example in table 6.2-9**

   The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.2-9: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server
   specific data), algorithm=AKAv1-MD5, ik="00112233445566778899aabbccddeeff",
   ck="ffeeddccbbaa11223344556677889900"
CSeq: 1 REGISTER
Content-Length: 0
```

WWW-Authenticate: The S-CSCF challenges the user. The nonce includes the quoted string, base64 encoded value of the concatenation of the AKA RAND, AKA AUTN and server specific data. The S-CSCF appends also the Integrity Key (IK) and the Cyphering key (CK).

NOTE 2: The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like: nonce="A34Cm+Fva37UYWpGNB34JP"

10. **401 Unauthorized response (I-CSCF to P-CSCF) - see example in table 6.2-10**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 6.2-10: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

11. **401 Unauthorized response (P-CSCF to UE) - see example in table 6.2-11**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 6.2-11: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
From:
To:
Call-ID:
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server
   specific data), algorithm=AKAv1-MD5
Security-Server: ipsec-3gpp; q=0.1; alg=hmac-sha-1-96; spi=87654321; port1=7531
CSeq:
Content-Length:
```

WWW-Authenticate: The P-CSCF removes the ik and ck parameters (directives) from the header.

Security-Server: q is the preference value, 0.1 means IPsec is the first preferred choice. The q value represents only relative degradation of all mechanisms listed here. The lower value, the higher prority.

12. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

13. **REGISTER request (UE to P-CSCF) - see example in table 6.2-13**

Table 6.2-13 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 70
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=7200
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1"
Security-Verify: ipsec-3gpp; q=0.1; alg=hmac-sha-1-96; spi=87654321; port1=7531
CSeq: 2 REGISTER
Supported: path
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 11 along with the private user identity, the realm, the nonce, the URI and the algorithm.

This message is protected by the IPsec SA negotiated.

14. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs the DNS queries to locate the I-CSCF in the home network. The look up in the DNS is based on the domain name specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port number are not indicated, the P-CSCF performs an NAPTR query for the domain specified in the Request-URI.

Table 6.2-14a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [14].

Table 6.2-14b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net          0 IN NAPTR 50   50 "s" "SIP+D2U"    ""
     _sip._udp.registrar.home1.net
                     0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                     0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""  _sips._tcp.registrar.home1.net
```

Based on the order and preference of the NAPTR record and the local preference, UDP is preferred and the P-CSCF finds the I-CSCF by an DNS SRV lookup according to RFC 2782 [4].

Table 6.2-14c DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.2-14d DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                     0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

15. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.2-15**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.2-15 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 69
P-Access-Network-Info:
Path: <sip:term@pcscf1.visited1.net;lr>
Require: path
P-Visited-Network-ID: "Visited Network Number 1"
P-Charging-Vector: icid-value=a834bc192fe3; icid-generated-at=[5555::e9e:d8d:c7c:b6b]
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-
   protected="yes"
CSeq:
Supported:
Expires:
Content-Length:
```

Path: This is the P-CSCF URI and it is included to inform the S-CSCF where to route terminating requestssessions.

16. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF name which was previously selected in step 5 (Cx: User registration status query procedure).

For detailed message flows see 3GPP TS 29.228.

Table 6.2-16a provides the parameters in the REGISTER request (flow 15), which are sent to the HSS.

Table 6.2-16a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	P-Visited-Network-ID:	This information indicates the network identifier of the visited network

17. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.2-17**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF.

Table 6.2-17: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 68
P-Access-Network-Info:
Path:
Require:
P-Visited-Network-ID:
P-Charging-Vector:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Supported:
~~Expires:~~
Content-Length:
```

Path: The S-CSCF stores the contents of the Path header and uses this URI ~~for routing mobile terminated sessions~~for routing mobile terminated requests.

P-Charging-Vector: The S-CSCF stores the contents of the icid parameters for possible charging activities.

18. **Authentication**

Upon receiving an integrity protected REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

19. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. Upon being requested by the S-CSCF , the HSS will also include the user profile in the response sent to the S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-19a provides the parameters in the REGISTER request (flow 17), which are sent to the HSS.

Table 6.2-19a Cx: S-CSCF registration notification procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

20. **200 OK response (S-CSCF to I-CSCF) - see example in table 6.2-20**

The S-CSCF sends a 200 (OK) response to the I-CSCF indicating that Registration was successful.

Table 6.2-20: 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path: <sip:term@pcscf1.visited1.net;lr>
Service-Route: <sip:scscf1.home1.net:1481orig@scscf1.home1.net;lr>
From:
To:
Call-ID:
Contact: <sip:[5555::aaa:bbb:ccc:ddd]>:1357;comp=sigcomp;expires=7200>;expires=7200
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
P-Associated-URI: <sip:user1_public2@home1.net>, <sip:user1_public3@home1.net>, <sip:+1-212-
   555-1111@home1.net;user=phone>
Content-Length:
```

Service-Route: The S-CSCF inserts the Service-Route header value that includes the its own S-CSCF URI including a port number to differentiate mobile originating requests from mobile terminating requests.

21. **200 OK response (I-CSCF to P-CSCF) - see example in table 6.2-21**

The I-CSCF forwards the 200 (OK) response from the S-CSCF to the P-CSCF indicating that the rRegistration was successful.

Table 6.2-21: 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route:
From:
To:
Call-ID:
Contact:
CSeq:
Date:
P-Associated-URI:
Content-Length:
```

22. **200 OK response (P-CSCF to UE) - see example in table 6.2-22**

The P-CSCF saves the value of the Service-Route header and associates it with the UE. The P-CSCF then forwards the 200 (OK) response from the I-CSCF to the UE indicating that the Rregistration was successful.

Table 6.2-22: 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route:
From:
To:
Call-ID:
Contact:
CSeq:
Date:
P-Associated-URI:
Content-Length:
```

6.3 Registration signalling: reregistration - user currently registered

For the purpose of the reregistration signalling flow shown in figure 6.3-1, the subscriber is considered to be roaming. The HSS information indicates that the subscriber is registered and authenticated, and that the S-CSCF has been allocated to this subscriber. In this signalling flow, the home network does not have network configuration hiding active. This flow also shows the authentication of the private user identity.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for reregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 is completed first.

~~Editor's Note: If the same PDP Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?~~

2. The DHCP procedure employed for P-CSCF discovery is not needed.

3. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

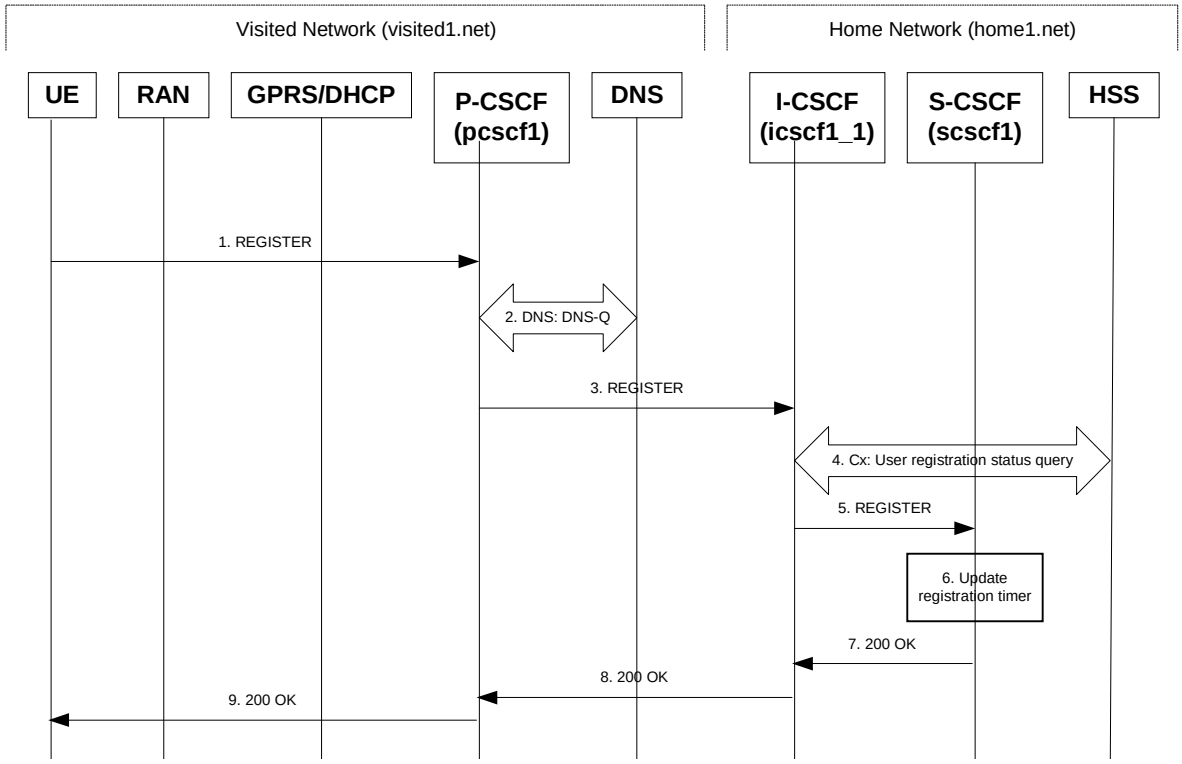

Figure 6.3-1: Reregistration when UE roaming

1. **REGISTER request (UE to P-CSCF) - see example in table 6.3-1**

   The registration expires in the UE. The UE reregisters by sending a new REGISTER request. This request is sent to the same P-CSCF with which the UE initially registered. The P-CSCF maintains the same binding between the public user address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which it established during the original registration.

Table 6.3-1: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 70
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=7200
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-
   protected="yes"
Security-Client: ipsec-3gpp; alg=hmac-sha-1-96; spi=12345678; port1=1357
Require: sec-agree
CSeq: 3 REGISTER
Supported: path
Expires: 7200
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity being registered. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and the S-CSCF.

Authorization: It carries authentication information. The private user identity (user1_private@home1.net) is carried in the username field of the Digest AKA protocol. As this is a re-registration process, the cached information (realm, nonce, algorithm, uri, response) is also sent.

NOTE 1: The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like: nonce="A34Cm+Fva37UYWpGNB34JP"

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Supported: This header is included to indicate to the recipient that the UE supports the Path header.

Upon receiving this request the P-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

2. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs the DNS queries to locate the I-CSCF in the home network. The look up in the DNS is based on the domain name specified in the Request URI. The DNS provides the P-CSCF with the address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.3-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 6.3-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info:
Max-Forwards: 69
Path: <sip:term@pcscf1.visited1.net;lr>
Require: path
P-Visited-Network-ID: "Visited Network Number 1"
P-Charging-Vector: icid-value=a834bc192fe3; icid-generated-at=[5555::e9e:d8d:c7c:b6b]
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-
   protected="yes"
CSeq:
Supported:
Expires:
Content-Length:
```

Path: This is the P-CSCF URI and is included to inform the S-CSCF where to route terminating requestssessions.

Require: This header is included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

P-Visited-Network-ID: It contains the identifier of the P-CSCF network at the home network.

P-Charging-Vector: The P-CSCF inserts this header and populates the icid parameters with the same unique value and the IP address of the P-CSCF that was used in the previous registration.

4. **Cx: User registration status query procedure**

   The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber.

   For detailed message flows see 3GPP TS 29.228.

   For the parameters in the REGISTER request (flow 3) which need to be sent to HSS, see table 6.2-5a.

   Table 6.3-4a provides the parameters in the REGISTER request (flow 5), which are obtained from the information sent back from the HSS.

Table 6.3-4a Cx: User registration status query procedure (HSS to I-CSCF)

Message source & destination	Cx Information element name	Mapping to SIP header in REGISTER	Description
HSS to I-CSCF	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

5. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.3-5**

   This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 6.3-5: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
    pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
    [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info:
Max-Forwards: 68
Path:
Require:
P-Visited-Network-ID:
P-Charging-Vector:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Supported:
~~Expires:~~
Content-Length:
```

Path: The S-CSCF stores the contents of the Path header and uses this URI ~~for routing mobile terminated sessions~~for routing mobile terminated requests.

P-Visited-Network-ID: It contains the identifier of the P-CSCF network at the home network.

Upon receiving this request the S-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

6. **Update registration timer**

As the REGISTER request arrived integrity protected, the S-CSCF does not need to challenge the user, but just update the registration timer to the value requested by the user (if the policy of the network allows it).

NOTE: The S-CSCF is allowed to challenge the user. If S-CSCF decides to challenge the user, the call flow will be similar to the one presented in section 6.2.

7. **200 OK response (S-CSCF to I-CSCF) – see example in Table 6.3-7**

The S-CSCF sends a 200 (OK) response to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 6.3-7 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
     pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
     [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route: <sip:~~scscf1.home1.net:1481~~orig@scscf1.home1.net;lr>
From:
To:
Call-ID:
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357~~>~~;comp=sigcomp~~;expires=7200~~>;expires=7200
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
P-Associated-URI: <sip:user1_public2@home1.net>, <sip:user1_public3@home1.net>, <sip:+1-212-
   555-1111@home1.net;user=phone>
Content-Length:
```

~~**Service-Route:** The S-CSCF inserts the Service-Route header value that includes the own S-CSCF URI~~

Service-Route: The S-CSCF inserts the Service-Route header that includes its own URI including a port number to differentiate mobile originating requests from mobile terminating requests.

8. **200 OK response (I-CSCF to P-CSCF) – see example in Table 6.3-8**

The I-CSCF forwards the 200 (OK) response from the S-CSCF to the P-CSCF indicating that the rRegistration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 6.3-8 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
     [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route:
From:
To:
Call-ID:
Contact:
CSeq:
Date:
P-Associated-URI:
Content-Length:
```

9. **200 OK response (P-CSCF to UE) – see example in Table 6.3-9**

The P-CSCF saves the value of the Service-Route header and associates it with the UE. The P-CSCF then forwards 200 (OK) response from the I-CSCF to the UE indicating that the Rregistration was successful.

Table 6.3-9 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route:
From:
To:
Call-ID:
Contact:
CSeq:
Date:
P-Associated-URI:
Content-Length:
```

6.4 Registration signalling: mobile initiated deregistration (not provided)

An example of this flow is not shown in the present document.

6.5 UE subscription for the registration state event package

This subclause describes the subscription procedure for the registration state event , whereby the UE requests to be notified by the S-CSCF when the event has occurred. This is done using the information structure as indicated in 3GPP TS 24.229 [16].

It is assumed that the user has registered prior to initiating subscription of an event. Also, the subscriber is considered to be roaming and the home network operator does not desire to keep its internal configuration hidden from the visited network. For this example the trigger point at the P-CSCF for sending out the SUBSCRIBE request is the 200 (OK) response of the user's registration.

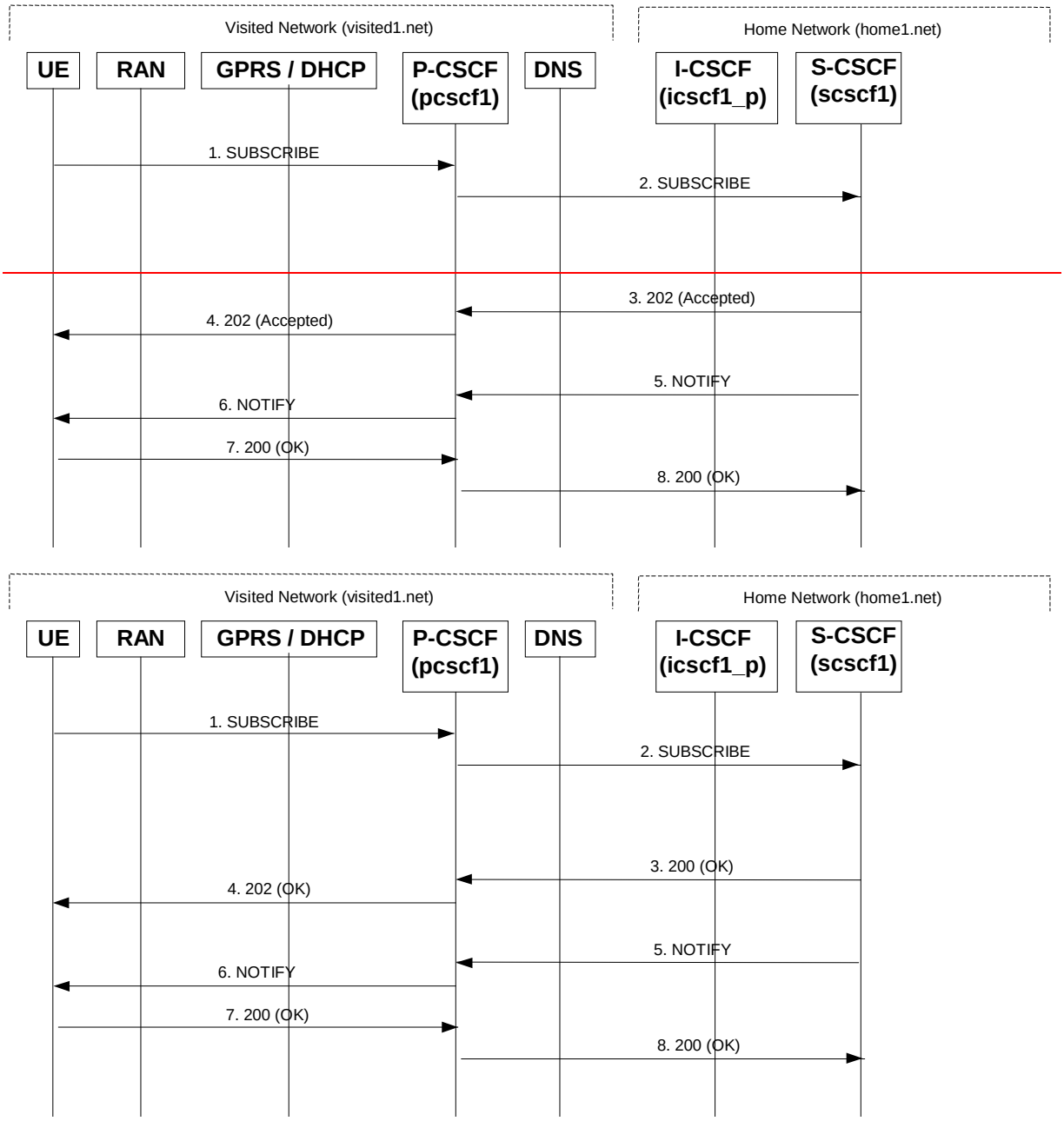

Figure 6.5-1: UE subscription for the registration state event package (without I-CSCF providing configuration independence)

1. **SUBSCRIBE request (UE to P-CSCF) - see example in table 6.5-1**

   The UE sends the SUBSCRIBE request for the reg event package.

Table 6.5-1: SUBSCRIBE request (UE to P-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 70
Route: <sip:pcscf1.visited1.net:7531;lr;comp=sigcomp>,
   <sip:scscf1.home1.net:1481orig@scscf1.home1.net;lr>
P-AssertedPreferred-Identity: "John Doe" <sip:user1_public1@home1.net>
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
Privacy: none
From: <sip:user1_public1@home1.net>;tag=31415
To: <sip:user1_public@home1.net>
Call-ID: b89rjhnedlrfjflslj40a222
Require: sec-agree
Proxy-Require: sec-agree
CSeq: 61 SUBSCRIBE
Event: reg
Expires: 7200
Accept: application/cpim-pidf+xml
Security-Verify: ipsec-3gpp; q=0.1; alg=hmac-sha-1-96; spi=87654321; port1=7531
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>>;expires=7200
Content-Length: 0
```

From: The user does not require privacy, the From header contains the value requested by the user.

Privacy: The user does not require privacy, therefore the Privacy header is set to the value “none” as specified in draft ietf sip asserted identity [17] and draft ietf sip privacy generalin RFC 3323 [13].

Route: contains the P-CSCF address learnt during P-CSCF discovery, plus the elements from the Service-Route header from registration. The P-CSCF URI contains the port number learnt during the security agreement negotiation.

P-AssertedPreferred-Identity: The user provides a hint about the identity to be used for this sessiondialog.

P-Access-Network-Info: the UE provides the access-type and access-info, related to the serving access network as specified in sub-clause ' Additional coding rules for P-Access-Network-Info header', in 3GPP TS 24.229 [16].

Event: This field is populated with the value 'reg' to specify the use of the registration state package.

Accept: This field is populated with the value 'application/cpim-pidf+xml'.

Upon receiving the SUBSCRIBE request, the P-CSCF stores the following information about this dialog, for use in possible error recovery actions - see example in table 6.5-1b.

Table 6.5-1b: Storage of information at P-CSCF

```
Request-URI: sip:user1_public1@home1.net
From: <sip:user1_public1@home1.net>;tag=31415
To: <sip:user1_public@home1.net>
Call-ID: b89rjhnedlrfjflslj40a222
Cseq(2dest): 61 SUBSCRIBE
Cseq(2orig): none
Route(2dest): <sip:scscf1.home1.net:1481orig@scscf1.home1.net;lr>
Contact(orig): <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=7200
```

2. **SUBSCRIBE request (P-CSCF to S-CSCF) - see example in table 6.5-2**

P-CSCF looks up the serving network information for the public user identity that was stored during the registration procedure. The SUBSCRIBE request is forwarded to the S-CSCF.

Table 6.5-2: SUBSCRIBE request (P-CSCF to S-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
     [5555::aaa:bbb:ccc:ddd].1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 69
Route: <sip:~~scscf1.home1.net:1481~~orig@scscf1.home1.net;lr>
Record-Route: <sip:pcscf1.home1.net;lr>
P-Asserted-Identity: "John Doe" <sip:user1_public1@home1.net>
P-Access-Network-Info:
P-Charging-Vector: icid-value=a834bc192fe3; icid-generated-at=[5555::e9e:d8d:c7c:b6b]
Privacy:
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Accept:
Contact:
Content-Length:
```

~~**Route:** Contains the elements from the Path header from registration.~~

P-Asserted-Identity: P-CSCF inserts the SIP URI in the P-Asserted-Identity header field and it also removes P-Preferred-Identity header field.~~**P-Asserted-Identity:** The P-CSCF inserts this header based on the user's hint present in the incoming P-Asserted-Identity header.~~

P-Charging-Vector: The P-CSCF inserts this header and populates the icid parameters with a unique value and the IP address of the P-CSCF.

Upon receiving the ~~INVITE~~SUBSCRIBE, the S-CSCF stores the following information about this dialog~~session~~, for use in possible charging and error recovery actions - see example in table 6.5-2b.

Table 6.5-2b: Storage of information at S-CSCF

```
Request-URI: sip:user1_public1@home1.net
From: sip:user1_public1@home1.net;tag=31415
To: sip:user1_public@home1.net
Call-ID: b89rjhnedlrfjflslj40a222
Cseq(2dest): 61 SUBSCRIBE
Cseq(2orig): none
P-Charging-Vector: icid-value=a834bc192fe3; icid-generated-at=[5555::e9e:d8d:c7c:b6b]
Route(2orig): <sip:pcscf1.home1.net;lr>
Contact(orig): <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=7200
```

3. ~~**202 (Accepted)**~~**200 (OK) response (S-CSCF to P-CSCF) - see example in table 6.5-3**

The S-CSCF first authorizes the subscription. As S-CSCF can trust the content of the P-Asserted-Identity header and <sip:user1_public1@home1.net> is on the list of the authorized users for the 'reg' event package stored by the S-CSCF, therefore the S-CSCF sends an acknowledgement towards the UE indicating that the subscription was successful. This response will traverse the path that the SUBSCRIBE request took as described in the Via list.

~~NOTE 1: If the S-CSCF can process the SUBSCRIBE request and send the NOTIFY request immediately, it can send a 200 (OK) response instead of a 202 (Accepted) response.~~

Table 6.5-3: ~~202 (Accepted)~~200 (OK) response (S-CSCF to P-CSCF)

```
SIP/2.0 ~~202 Accepted~~200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
     [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Record-Route: <sip:pcscf1.home1.net;lr>
P-Asserted-Identity: <sip:scscf1.home1.net>
Privacy: none
From:
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq:
Event:
Expires:
Contact: <sip:scscf1.home1.net>
Content-Length:
```

Expires: If the value of the Expires header in SUBSCRIBE request is different from the one received in REGISTER method, then the value of Expires header in the ~~202 (Accepted)~~200 (OK) response is set to match the value of Expires header in REGISTER method.

4. **~~202 (Accepted)~~200 (OK) response (P-CSCF to UE) - see example in table 6.5-4**

P-CSCF sends the response to UE.

Table 6.5-4: ~~202 (Accepted)~~200 (OK) response (P-CSCF to UE)

```
SIP/2.0 ~~202 Accepted~~200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
Record-Route:<sip:pcscf1.home1.net:7531;lr;comp=sigcomp>
P-Asserted-Identity:
Privacy:
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Contact:
Content-Length:
```

5. **NOTIFY request (S-CSCF to P-CSCF) - see example in table 6.5-5**

The S-CSCF sends a first NOTIFY request towards the UE in order to inform the UE about the registration status of the monitored user.

In the example below, the NOTIFY request specifies the following public user identity as registered (i.e. status=open): sip:user1_public1@home1.net, tel: +498972233114.

The following public user identity has been deregistered (i.e. status=closed) sip:user1_public2@home1.net. They are arranged in the preferred order of priority in this example.

~~The Route header is constructed from the information saved at registration.~~

Table 6.5-5: NOTIFY request (S-CSCF to P-CSCF)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
Route: <sip:pcscf1.home1.net;lr>
From: <sip:user1_public1@home1.net>;tag=31415
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq: 42 NOTIFY
Subscription-State: active;expires=7200
Event: reg
Content-Type: application/cpim-pidf+xml
Contact: <sip:scscf1.home1.net>
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:">

        <tuple name="sip:user1_public1@home1.net">
          <status><basic>open</basic></status>
        </tuple>

        <tuple name="sip:user1_public2@home1.net">
          <status><basic>closed</basic></status>
        </tuple>

        <tuple name="tel:+498972233114">
          <status><basic>open</basic></status>
        </tuple>

      </presence>
```

From: The tag of this field matches that of the To; field in the received 200 (OK)~~/202~~ response for the SUBSCRIBE request.

Content-Type: Set to the value of the Accept header received in the SUBSCRIBE request or 'application/cpim-pidf+xml' if the Accept header was not present in the SUBSCRIBE request.

The message body in the NOTIFY request that carries the subscriber's registration state is formed as indicated in 3GPP TS 24.229 [16].

6. **NOTIFY request (P-CSCF to UE) - see example in table 6.5-6**

The P-CSCF forwards the NOTIFY request to the UE.

Table 6.5-6: NOTIFY request (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 69
From:
To:
Call-ID:
CSeq:
Subscription-State:
Event:
Content-Type:
Contact:
Content-Length:
```

7. **200 (OK) response (UE to P-CSCF) – see example in table 6.5-7**

The UE generates a 200 (OK) response to the NOTIFY request.

Table 6.5-7 200 (OK) response (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

8. **200 (OK) response (P-CSCF to S-CSCF) - see example in table 6.5-8**

P-CSCF forwards the 200 (OK) to the S-CSCF.

Table 6.5-8: 200 (OK) response (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
P-Access-Network-Info:
From:
To:
Call-ID:
CSeq:
Content-Length:
```

6.6 P-CSCF subscription for the registration state event package (without I-CSCF providing configuration independence)

This section describes the subscription procedure for the network initiated deregistration event, whereby the P-CSCF requests to be notified by the S-CSCF when the event has occurred. This is done using the 'reg' package as described in 3GPP TS 24.229 [16].

It is assumed that the user has registered prior to initiating subscription of an event. Also, the subscriber is considered to be roaming and the home network operator does not desire to keep its internal configuration hidden from the visited network. For this example the trigger point at the P-CSCF for sending out the SUBSCRIBE request is the 200 (OK) response of the user's registration.

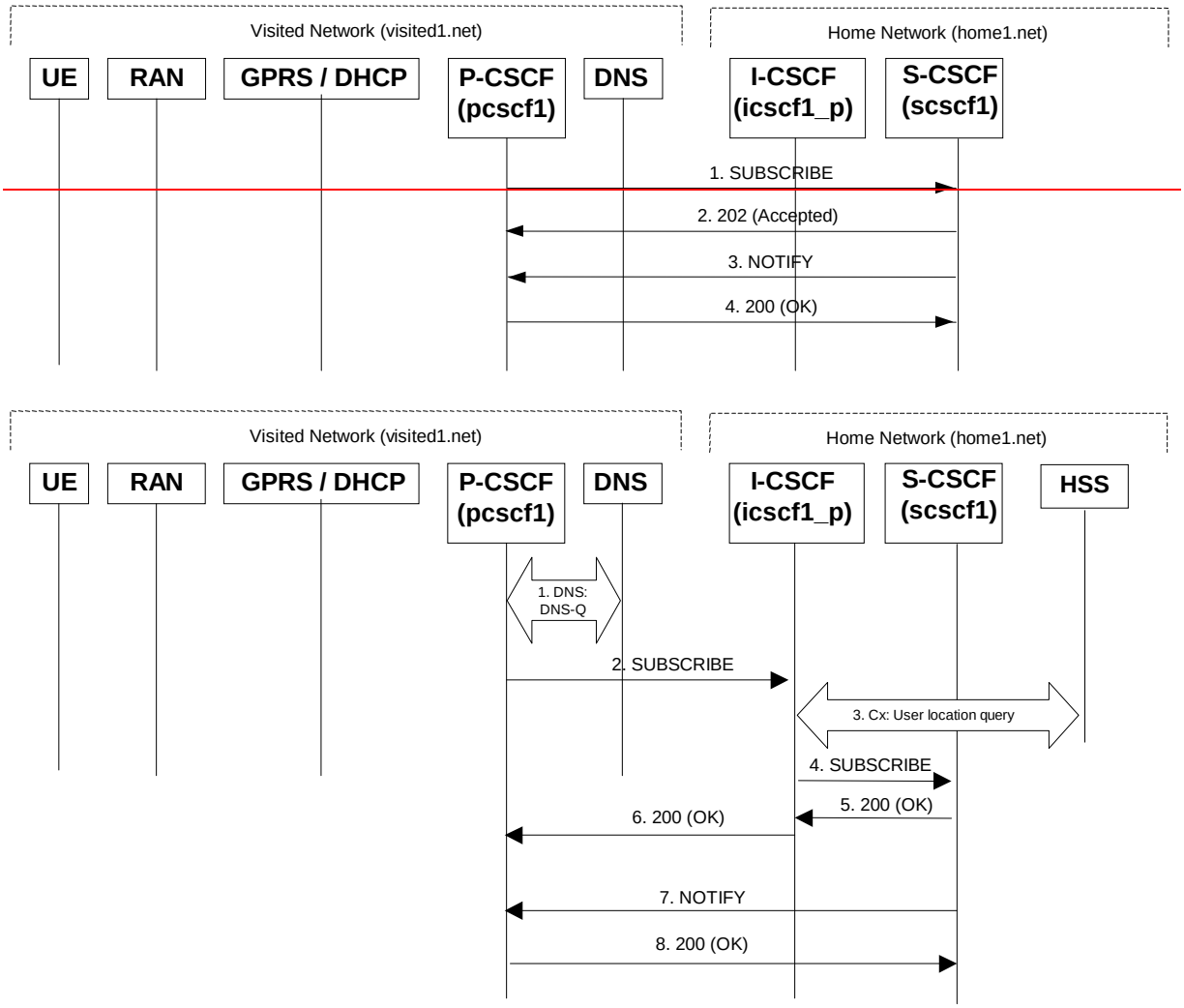

Figure 6.6-1: P-CSCF subscription for the registration state event package (without I-CSCF providing configuration independence)

1. **DNS: DNS-Q**

The P-CSCF performs the DNS queries to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

~~1~~2. **SUBSCRIBE request (P-CSCF to ~~S~~I-CSCF) - see example in table 6.6-2~~1~~**

The P-CSCF sends the SUBSCRIBE request for the reg event package.

Table 6.6-12: SUBSCRIBE request (P-CSCF to I-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1
Max-Forwards: 70
Route: <sip:scscf1.home1.net;lr>
P-Asserted-Identity: <sip:pcscf1.visited1.net>
Privacy: none
From: <sip:pcscf1.visited1.net>;tag=31415
To: <sip:user1_public1@home1.net>
Call-ID: dre36d2v32gnlgiiomm72445
CSeq: 61 SUBSCRIBE
Event: reg
Expires: 7200
Accept: application/cpim-pidf+xml
Contact: <sip:pcscf1.visited1.net>
Content-Length: 0
```

Route: Based on the Service-Route information.

From: This header is populated with the SIP URI that identifies the P-CSCF.

Contact: This is where the NOTIFY requests for this subscription will be sent. It consists of the SIP URI escaped public user identity at the P-CSCF.

Event: This field is set to the value 'reg' to specify the use of the reg event package.

Accept: This field is set to the value 'application/cpim-pidf+xml'.

3. **Cx: User Location Query procedure**

The I-CSCF sends a query to the HSS to find out the S-CSCF of the called user. The HSS responds with the address of the current S-CSCF for the terminating subscriber.

For detailed message flows see 3GPP TS 29.228 [11].

Table 6.6-3a provides the parameters in the SIP SUBSCRIBE request (flow 2), which are sent to the HSS.

Table 6.6-3a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx: Information element name	Information source in SIP INVITE	Description
I-CSCF to HSS	User Public Identity	Request-URI:	This information element indicates the public user identity

Table 6.6-3b provides the parameters sent from the HSS that need to be mapped to SIP SUBSCRIBE (flow 4) and sent to S-CSCF.

Table 6.6-3b Cx: User registration status query procedure (HSS to I-CSCF)

Message source & destination	Cx: Information element name	Mapping to SIP header in SIP INVITE	Description
HSS to I-CSCF	S-CSCF name	Route header field	This information indicates the serving CSCF's name of that user

4. **SUBSCRIBE request (I-CSCF to S-CSCF) - see example in table 6.6-4**

The I-CSCF forwards the SUBSCRIBE request to the S-CSCF.

Table 6.6-4: SUBSCRIBE request (I-CSCF to S-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK871y12.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1
Max-Forwards: 69
Route: <sip:scscf1.home1.net;lr>
P-Asserted-Identity:
Privacy:
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Accept:
Contact:
Content-Length:
```

2. ~~202 (Accepted)~~200 (OK) **response (S-CSCF to ~~P~~I-CSCF) - see example in table 6.6-5~~2~~**

The S-CSCF first authorizes the subscription. As S-CSCF can trust the content of the P-Asserted-Identity header and <sip:pcscf1.visited1.net> is on the list of the authorized users for the 'reg' event package stored by the S-CSCF, therefore the S-CSCF sends an acknowledgement towards the ~~P~~I-CSCF indicating that the subscription was successful. ~~This response will traverse the path that the SUBSCRIBE request took as described in the Via list.~~

~~NOTE 1: If the S-CSCF can process the SUBSCRIBE request and send the NOTIFY request immediately, it can send a 200 (OK) response instead of a 202 (Accepted) response.~~

Table 6.6-5~~2~~: ~~202 (Accepted)~~200 (OK) response (S-CSCF to ~~P~~I-CSCF)

```
SIP/2.0 ~~202 Accepted~~200 OK
Via: SIP/2.0/UDP icscf1_s.home1.net;branch=z9hG4bK871y12.1, SIP/2.0/UDP
     pcscf1.visited1.net;branch=z9hG4bK240f34.1
P-Asserted-Identity: <sip:scscf1.home1.net>
Privacy: ~~none~~
From:
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq:
Contact: <sip:scscf1.home1.net>
Event:
Expires:
Content-Length:
```

Expires: If value of the Expires header in SUBSCRIBE request is different from the one received in REGISTER method, then the value of Expires header in the ~~202 (Accepted)~~200 (OK) response is set to match the value of Expires header in REGISTER method.

6. **200 (OK) response (I-CSCF to P-CSCF) - see example in table 6.6-6**

The I-CSCF forwards the 200 (OK) response to the P-CSCF.

Table 6.6-6: 200 (OK) response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1
P-Asserted-Identity:
Privacy:
From:
To:
Call-ID:
CSeq:
Contact:
Event:
Expires:
Content-Length:
```

~~3~~7. NOTIFY request (S-CSCF to P-CSCF) - see example in table 6.6-7~~3~~

The S-CSCF sends a first NOTIFY request towards the P-CSCF in order to inform the P-CSCF about the registration status of monitored user.

Table 6.6-~~3~~7: NOTIFY request (S-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.visited1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@pcscf1.visited1.net>;tag=31415
Call-ID: dre36d2v32gnlgiiomm72445
CSeq: 42 NOTIFY
Subscription-State: active;expires=7200
Event: reg
Content-Type: application/cpim-pidf+xml
Contact: <sip:scscf1.home1.net>
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:">

        <tuple name="sip:user1_public1@home1.net">
          <status><basic>closed</basic></status>
        </tuple>

</presence>
```

From: The tag of this field matches that of the To; field in the received 200 (OK)~~/202~~ response for the SUBSCRIBE request.

Content-Type: Set to the value of the Accept header received in the SUBSCRIBE request or 'application/cpim-pidf+xml' if the Accept header was not present in the SUBSCRIBE request.

The message body in the NOTIFY request that carries the subscriber's registration state is formed as indicated in 3GPP TS 24.229 [16].

~~4~~8. 200 (OK) response (P-CSCF to S-CSCF) - see example in table 6.6-8~~4~~

P-CSCF forwards the 200 (OK) response to the S-CSCF.

Table 6.6-8~~4~~: 200 (OK) response (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
From:
To:
Call-ID:
CSeq:
Content-Type:
Content-Length: 0
```

6.7 Notifying of the network-initiated deregistration event

6.7.1 Network-initiated deregistration event occurs in the S-CSCF

Figure 6.7.1-1 assumes that the UE and the P-CSCF both have subscribed for the user's registration state event package according to subclause 6.5 and shows how the UE and the P-CSCF are notified when the network-initiated deregistration event occurs in the S-CSCF.

Also, it is assumed that the home network does not have network configuration hiding active.

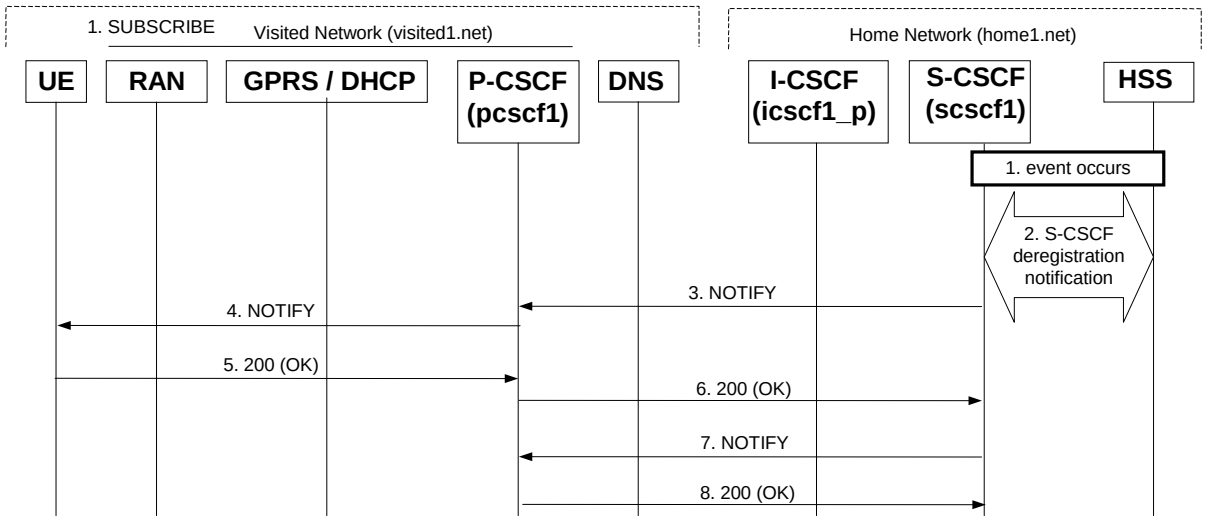

Figure 6.7.1-1: Network Initiated Deregistration event occurs in the S-CSCF

1. **Network Initiated Deregistration event occurs in the S-CSCF**

2. **S-CSCF deregistration notification**

   When the Network Initiated Deregistration Event occurs in the S-CSCF, the S-CSCF informs the HSS that the user is no longer registered. The S-CSCF either notifies the HSS to clear or requests to keep its location information for that subscriber. The HSS then either clears or keeps the S-CSCF name for that subscriber according to request. In both cases the state of the subscriber identity is stored as unregistered in the HSS and the S-CSCF. The HSS acknowledges the request.

   For detailed message flows see 3GPP TS 29.228 [11].

3 **SIP NOTIFY request (S-CSCF to P-CSCF) - see example in table 6.7.1-3**

   After the S-CSCF deregistration notification procedure the S-CSCF immediately sends a NOTIFY request towards the UE in order to inform about the network initiated deregistration and the subscription termination. The same Request URI, To, From, Call-ID are used as in the first NOTIFY request. CSeq is incremented since this is the second NOTIFY request sent towards the UE.

Table 6.7.1-3: SIP NOTIFY request (S-CSCF to P-CSCF)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
Route: <sip:pcscf1.visited1.net;lr>
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@home1.net>;tag=31415
Call-ID: b89rjhnedlrfjflslj40a222
CSeq: 43 NOTIFY
Subscription-State: terminated
Event: reg
Content-Type: application/cpim-pidf+xml
Contact: sip:scscf1.home1.net
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:">

        <tuple name="sip:user1_public1@home1.net">
          <status><basic>closed</basic>
     <note>
         reason-phrase: "You have been deregistered from the network, please register again";
         registrar: registrar.home1.net
     </note>
     </status>
        </tuple>

   <tuple name="sip:user1_public2@home1.net">
          <status><basic>closed</basic></status>
        </tuple>

   <tuple name="tel:+498972233114">
          <status><basic>closed</basic>
         <note>
         reason-phrase: "This ID has been automatically deregistered";
         registrar: registrar.home1.net
         </note>
     </status>
        </tuple>

      </presence>
```

4. **SIP NOTIFY request (P-CSCF to UE) - see example in table 6.7.1-4**

   P-CSCF forwards the NOTIFY request to the UE.

Table 6.7.1-4: SIP NOTIFY request (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 69
From:
To:
Call-ID:
CSeq:
Subscription-State:
Event:
Content-Type:
Contact:
Content-Length:
```

5. **200 (OK) response (UE to P-CSCF) - see example in table 6.7.1-5**

Table 6.7.1-5: SIP 200 (OK) response (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6. **SIP 200 (OK) response (P-CSCF to S-CSCF) - see example in table 6.7.1-6**

Table 6.7.1-6: SIP 200 (OK) response (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
P-Access-Network-Info:
From:
To:
Call-ID:
CSeq:
Content-Length:
```

7 **SIP NOTIFY request (S-CSCF to P-CSCF) - see example in table 6.7.1-7**

~~After sending the Cx.Put request t~~The S-CSCF also ~~immediately~~ sends a NOTIFY request towards the P-CSCF to which the UE is attached to, in order to inform about the network initiated deregistration. The same Request URI, To, From, Call-ID are used as in the first NOTIFY request. CSeq is incremented since this is the second NOTIFY request sent towards the P-CSCF.

Table 6.7.1-7: SIP NOTIFY request (S-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.visitedhome1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:pcscf1.visisted1.net>;tag=31415
Call-ID: dre36d2v32gnlgiiomm72445
CSeq: 43 NOTIFY
Subscription-State: active;expires=5200terminated
Event: reg
Content-Type: application/cpim-pidf+xml
Contact: sip:scscf1.home1.net
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:">

        <tuple name="sip:user1_public1@home1.net">
          <status><basic>closed</basic>
         <note>
         reason-phrase: "This public ID has been deregistered by the network";
         registrar: registrar.home1.net
         </note>
     </status>
        </tuple>

   <tuple name="sip:user1_public2@home1.net">
          <status><basic>closed</basic></status>
        </tuple>

   <tuple name="tel:+498972233114">
          <status><basic>closed</basic>
         <note>
         reason-phrase: "This ID has been automatically deregistered";
         registrar: registrar.home1.net
         </note>
     </status>
        </tuple>

      </presence>
```

8. **SIP 200 (OK) response (P-CSCF to S-CSCF) - see example in table 6.7.1-8**

Table 6.7.1-8: SIP 200 (OK) response (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6.7.2 Network-initiated deregistration event occurs in the HSS

Figure 6.7.2-1 assumes that the UE and the P-CSCF both have subscribed for the user's registration state event package according to subclause 6.5 and shows how the UE and the P-CSCF are notified when the Network Initiated Deregistration event occurs in the HSS.

Also, it is assumed that the home network does not have network configuration hiding active.

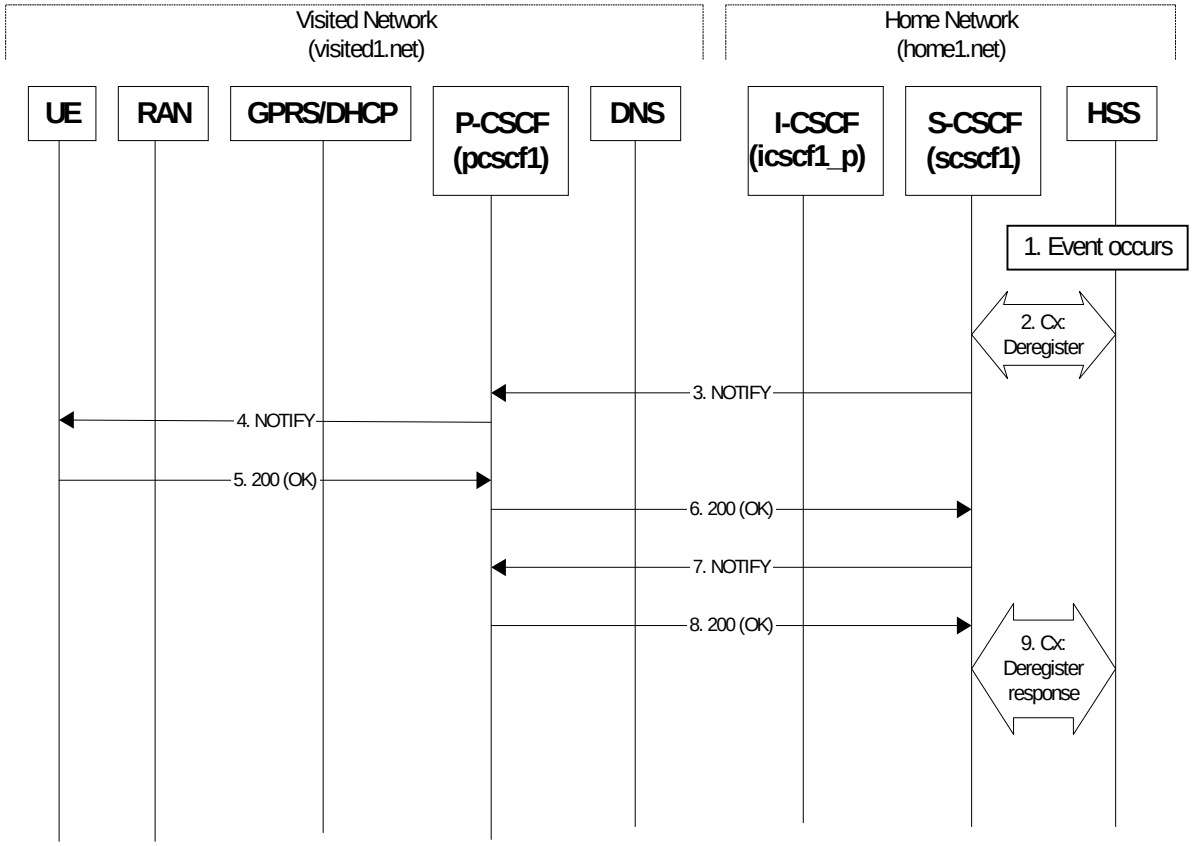

Figure 6.7.2-1: Network-initiated deregistration event occurs in the HSS

1. **Network-initiated deregistration event occurs in the HSS**

2. **Cx-Deregister**

   HSS initiates the deregistration, sending a Cx-Deregister (subscriber identity). For detailed message flows see 3GPP TS 29.228 [11].

3. **SIP NOTIFY request (S-CSCF to P-CSCF) - see example in table 6.7.2-3**

   After getting the Cx-Deregister message the S-CSCF immediately sends a NOTIFY request towards the UE order to inform about the network initiated deregistration and the subscription termination. The same Request URI, To, From, Call-ID are used as in the first NOTIFY request. CSeq is incremented since this is the second NOTIFY request sent towards the UE.

Table 6.7.2-3: SIP NOTIFY request (S-CSCF to P-CSCF)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
Route: <sip:pcscf1.visited1.net;lr>
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@home1.net>;tag=31415
Call-ID: b89rjhnedlrfjflslj40a222
CSeq: 43 NOTIFY
Subscription-State: terminated
Event: reg
Content-Type: application/cpim-pidf+xml
Contact: <sip:scscf1.home1.net>
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:">

        <tuple name="sip:user1_public1@home1.net">
          <status><basic>closed</basic>
     <note>
         reason-phrase: "You have been deregistered from the network, please register again";
         registrar: registrar.home1.net
     </note>
     </status>
        </tuple>

   <tuple name="sip:user1_public2@home1.net">
          <status><basic>closed</basic></status>
        </tuple>

   <tuple name="tel:+498972233114">
          <status><basic>closed</basic>
     <note>
         reason-phrase: "This ID has been automatically deregistered";
         registrar: registrar.home1.net
     </note>
     </status>
        </tuple>

      </presence>
```

4. **SIP NOTIFY request (P-CSCF to UE) - see example in table 6.7.2-4**

   P-CSCF forwards the NOTIFY request to the UE.

Table 6.7.2-4: SIP NOTIFY request (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 69
From:
To:
Call-ID:
CSeq:
Subscription-State:
Event:
Content-Type:
Contact:
Content-Length:
```

5. **SIP 200 (OK) response (UE to P-CSCF) - see example in table 6.7.2-5**

Table 6.7.2-5: SIP 200 (OK) response (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6. **SIP 200 (OK) response (P-CSCF to S-CSCF) - see example in table 6.7.2-6**

Table 6.7.2-6: SIP 200 (OK) response (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
P-Access-Network-Info:
From:
To:
Call-ID:
CSeq:
Content-Length:
```

7 **SIP NOTIFY request (S-CSCF to P-CSCF) - see example in table 6.7.2-7**

~~After receiving the 200 (OK) response from the UE t~~The S-CSCF also ~~immediately~~ sends a NOTIFY request towards the P-CSCF to which the UE is attached to, in order to inform about the network initiated deregistration. The same Request URI, To, From, Call-ID are used as in the first NOTIFY request. CSeq is incremented since this is the second NOTIFY request sent towards the P-CSCF.

Table 6.7.2-7: SIP NOTIFY request (S-CSCF to P-CSCF)

```
NOTIFY sip:pcscf1.visitedhome1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:pcscf1.visisted1.net>;tag=31415
Call-ID: dre36d2v32gnlgiiomm72445
CSeq: 43 NOTIFY
Subscription-State:-active;expires=527200
Event: reg
Contact: <sip:scscf1.home1.net>
Content-Type: application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:">

        <tuple name="sip:user1_public1@home1.net">
          <status><basic>closed</basic>
     <note>
         reason-phrase: "This public ID has been deregistered by the network";
         registrar: registrar.home1.net
     </note>
     </status>
        </tuple>

   <tuple name="sip:user1_public2@home1.net">
          <status><basic>closed</basic></status>
        </tuple>

   <tuple name="tel:+498972233114">
          <status><basic>closed</basic>
     <note>
         reason-phrase: "This ID has been automatically deregistered";
         registrar: registrar.home1.net
     </note>
     </status>
        </tuple>

      </presence>
```

8. **SIP 200 (OK) response (P-CSCF to S-CSCF) - see example in table 6.7.2-8**

Table 6.7.2-8 SIP 200 (OK) response (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

9. **Cx-Deregister Resp**

   After receiving the 200 (OK) response from the P-CSCF, the S-CSCF sends Cx-Deregister Resp to the HSS. For detailed message flows see 3GPP TS 29.228 [11].

6.7.3 Network-initiated deregistration upon UE roaming and registration to a new network - assumes that the previous registration has not expired

This shows the registration signalling flow for the scenario that the UE loses the GPRS attachment in current visited access network and roams to makes a new GPRS attachment in a new visited access network without deregistration from its previous network. The GGSN and P-CSCF are assumed to be in the visited network. When the UE starts registration in via the new visited access network and P-CSCF, the home S-CSCF in the home IMS network initiates the deregistration to the P-CSCF in the previous visited network. It is assumed that the old P-CSCF has subscribed the

event package to the S-CSCF and the subscription has not expired. For the reason of simplicity, the authentication procedure is not shown because it has no technical impact on this flow.

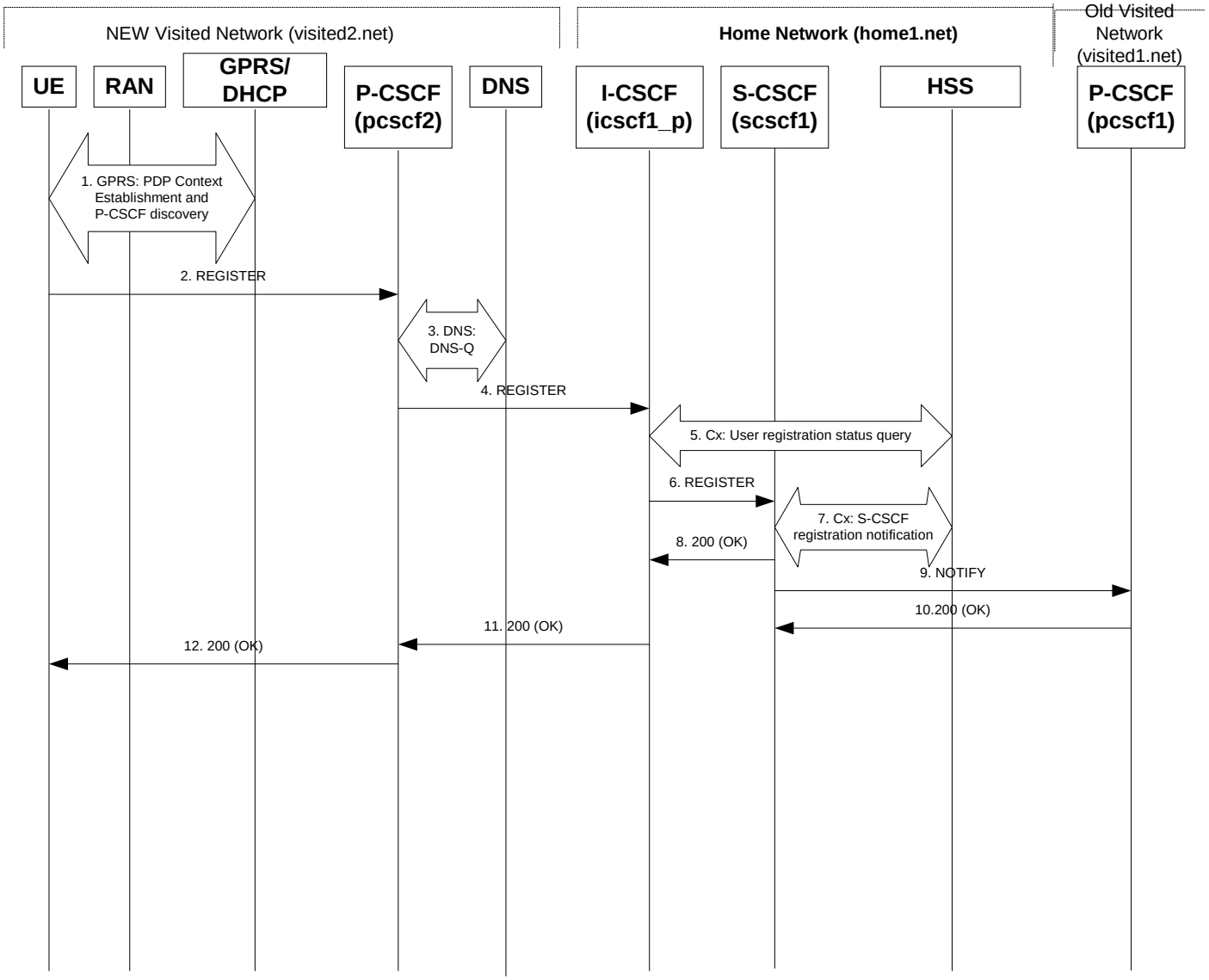

Figure 6.7.3-1: Network-initiated deregistration upon UE roaming without deregistration

Flows from 1 to 4 are the same as those in subclause 6.2.

5. **Cx: User Registration Status Query**

   The I-CSCF sends the Cx-Query signalling flow to the HSS (Visited Network Identifier, subscriber identity, home domain name,). Because user has not deregistered with its previous network, so that HSS finds a S-CSCF assigned for that user and treats this as a re-registration procedure. Therefore, the HSS returns the S-CSCF name to the I-CSCF.For detailed message flows see 3GPP TS 29.228 [11].

   For the parameters in the REGISTER request (flow 4) which need to be sent to HSS, see table 6.2-4a.

   Table 6.3-4a provides the parameters in the REGISTER request (flow 6) which are obtained from the information sent back from the HSS.

6. **REGISTER request (I-CSCF to S-CSCF)**

   The I-CSCF forwards the REGISTER request to the S-CSCF assigned to that user.

7. **Cx-S-CSCF Registration Notification**

The S-CSCF notifies the HSS to update its location information for that subscriber. The HSS sends a response to the S-CSCF to acknowledge the update of location information and also with the user profile.

9. **NOTIFY request (S-CSCF to Old P-CSCF) - see example in table 6.7.3-9**

~~Upon receiving flow 6, the S-CSCF found that the P-CSCF address in that message is different with the one in its database, so that the S-CSCF knows that the UE has left its previous P-CSCF without deregister itself.~~ ~~A~~As there was a change in the user's registration status and the old P-CSCF ~~has~~ is still subscribed ~~with~~ to the registration event package for that user, therefore, the S-CSCF sends a NOTIFY request to that P-CSCF.

Table 6.7.3-9: SIP NOTIFY request (S-CSCF to Old P-CSCF)

```
NOTIFY sip:pcscf1.~~home~~visited1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:pcscf1.visisted1.net>;tag=31415
Call-ID: dre36d2v32gnlgiiomm72445
CSeq: 43 NOTIFY
Subscription-State: ~~terminated~~active;expires=1200
Event: reg
Content-Type: application/cpim-pidf+xml
Contact: <sip:scscf1.home1.net>
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:">

        <tuple name="sip:user1_public1@home1.net">
          <status><basic>closed</basic>
     <note>
         reason-phrase: "This public ID has been deregistered by the network";
         registrar: registrar.home1.net
     </note>
     </status>
        </tuple>

   <tuple name="sip:user1_public2@home1.net">
          <status><basic>closed</basic></status>
        </tuple>

   <tuple name="tel:+498972233114">
          <status><basic>closed</basic>
     <note>
         reason-phrase: "This ID has been automatically deregistered";
         registrar: registrar.home1.net
     </note>
     </status>
        </tuple>

      </presence>
```

10. **SIP 200 (OK) response (Old P-CSCF to S-CSCF) - see example in table 6.7.3-10**

Upon receiving the NOTIFY request, the P-CSCF discards any information binding with that user.

Table 6.7.3-10: SIP 200 (OK) response (Old P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6.8 Network initiated re-authentication

This subclause describes the notification of a UE that occurs when the S-CSCF assigned to that user requests re-authentication.

It is assumed that user has registered and also subscribed to the registration state event before. Also, the subscriber is considered to be roaming and the home network operator does not desire to keep its internal configuration hidden from the visited network.

After this procedure the user's UE might automatically initiate re-registration procedures. If the user fails to re-register, the public user identity for which re-authentication is requested, the public user identity may be deregistered by S-CSCF.

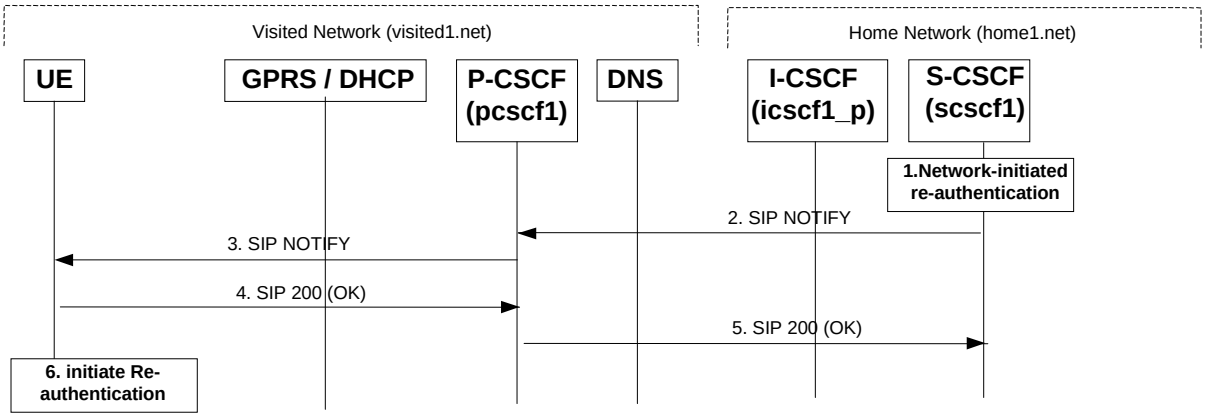

Figure 6.8-1: S-CSCF informs UE about network-initiated re-authentication event (without I-CSCF providing configuration independence)

1. **Network initiated re-authentication (S-CSCF)**

   The network initiated re-authentication event for the private user identity of the user occurs at the S-CSCF. As the user has subscribed to the registration state event package this is the trigger point for the S-CSCF to notify the user about the event occurrence. For simplicity, the NOTIFY request towards the P-CSCF is not shown.

2. **SIP NOTIFY request (S-CSCF to P-CSCF) - see example in table 6.8-2**

   The S-CSCF sends a NOTIFY request towards the UE in order to inform the UE about the occurrence of the network initiated re-authentication event.

   ~~The Route header is constructed from the information saved at registration.~~

Table 6.8-2: SIP NOTIFY request (S-CSCF to P-CSCF)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
Route: <sip:pcscf1.visited1.net;lr>
From: <sip:user1_public1@home1.net>;tag=31415
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID: b89rjhnedlrfjflslj40a222
CSeq: 43 NOTIFY
Subscription-State: active;expires=37200
Event: reg
Content-Type: application/cpim-pidf+xml
Contact: sip:scscf1.home1.net
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:"
      xmlns:registration="urn:ietf:params:xml:ns:cpim-pidf:registration">

        <tuple name="sip:user1_public1@home1.net">
          <status>
         <basic>open</basic>
          <registration>re-authenticate</registration>
     </status>
        </tuple>
      </presence>
```

From: The tag of this field matches that of the To; field in the received 200 (OK)~~/202~~ response for the SUBSCRIBE request.

Content-Type: Set to the value of the Accept header received in the SUBSCRIBE request or 'application/cpim-pidf+xml' if the Accept header was not present in the SUBSCRIBE request.

The message body in NOTIFY request that carries the subscriber's registration state is formed as indicated in 3GPP TS 24.229 [16].

3. **SIP NOTIFY request (P-CSCF to UE) - see example in table 6.8-3**

The P-CSCF forwards the NOTIFY request to UE.

Table 6.8-3: SIP NOTIFY request (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 69
From:
To:
Call-ID:
CSeq:
Subscription-State:
Event:
Content-Type:
Contact:
Content-Length:
```

4. **SIP 200 (OK) response (UE to P-CSCF) - see example in table 6.8-4**

The UE generates a 200 (OK) response to the NOTIFY request.

Table 6.8-4: SIP 200 (OK) response (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

5. **SIP 200 (OK) response (P-CSCF to S-CSCF) - see example in table 6.8-5**

P-CSCF forwards the 200 (OK) response to the S-CSCF.

Table 6.8-5: SIP 200 (OK) response (P-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
P-Access-Network-Info:
From:
To:
Call-ID:
CSeq:
Content-Length:
```

6. **Re-authentication (UE)**

The UE now initiates re-authentication procedures.

6.9 Registration error conditions

6.9.1 Reregistration - failure of reregistration

See subclause 16.9.1.

6.9.2 User not registered, user not allowed to roam / user unknown

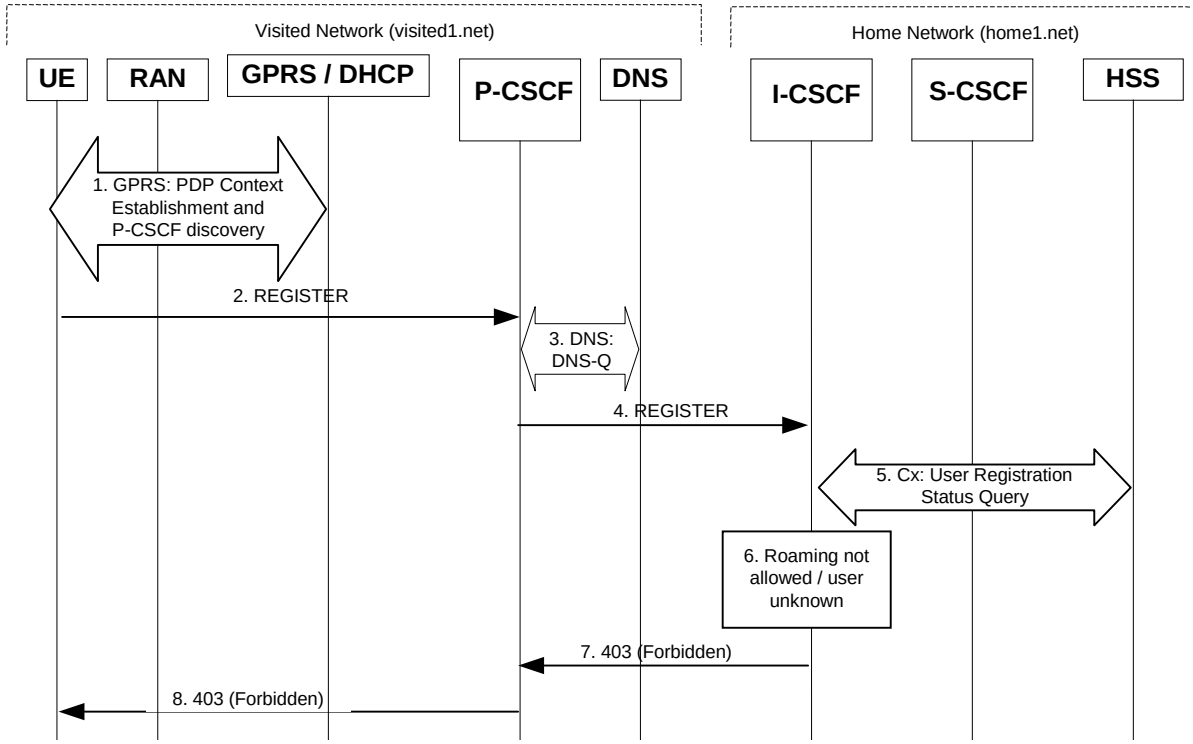

Figure 6.9.2-1: Registration failure: User not registered, user not allowed to roam

The first five steps are similar with the regular Registration signalling flows described in subclause 6.2.

The "Roaming not allowed" and "User unknown" error conditions would result in the same signalling flow (only the actions taken by I-CSCF will differ), thus the signalling flows are merged and only the I-CSCF action is described depending on the error condition.

6. **Roaming not allowed / User unknown**

   The information received as a response to the Cx-Query may indicate that "Roaming is not allowed" for the subscriber from the visited1.net network. In this case I-CSCF needs to send a 403 (Forbidden) response back to the UE. I-CSCF will insert a warning header in the response, indicating to the UE the reason of refusing the Registration request. Warning header will contain the name of the network inserting the warning header (warn-agent = home1.net) and in addition it may contain a warn-text.The warn-code inserted into the Warning header is 399.

   When the information received as a response to the Cx-Query indicates that the subscriber is unknown to the network or the subscriber does not have a valid subscription, the I-CSCF needs to send a 403 (Forbidden) response back to the UE. I-CSCF will insert a warning header in the response, indicating to the UE the reason of refusing the Registration request. Warning header will contain the name of the network inserting the warning header (warn-agent = home1.net) and in addition it may contain a warn-text. The warn-code inserted into the Warning header is 399.

7. **403 (Forbidden) response (I-CSCF to P-CSCF) - see example in table 6.9.2-7**

Table 6.9.2-7: 403 (Forbidden) response (I-CSCF to P-CSCF)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
     [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
Warning: 399 home1.net "Roaming not allowed from this network"
From:
To:
Call-ID:
Cseq:
Content-Length: 0
```

8. **403 (Forbidden) response (P-CSCF to UE) - see example in table 6.9.2-8**

Table 6.9.2-8: 403 (Forbidden) response (P-CSCF to UE)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd];comp=gigcomp;branch=z9hG4bKnashds7
Warning: 399 home1.net "Roaming not allowed from this network"
From:
To:
Call-ID:
Cseq:
Content-Length:
```

6.9.3 Registration failure – user authentication failure

This clause (see figure 6.9.3-1) shows the signalling flow with user authentication failure at step 19 of subclause 6.2 "Signalling flows for REGISTER" and a final failure of the authentication at step 30.

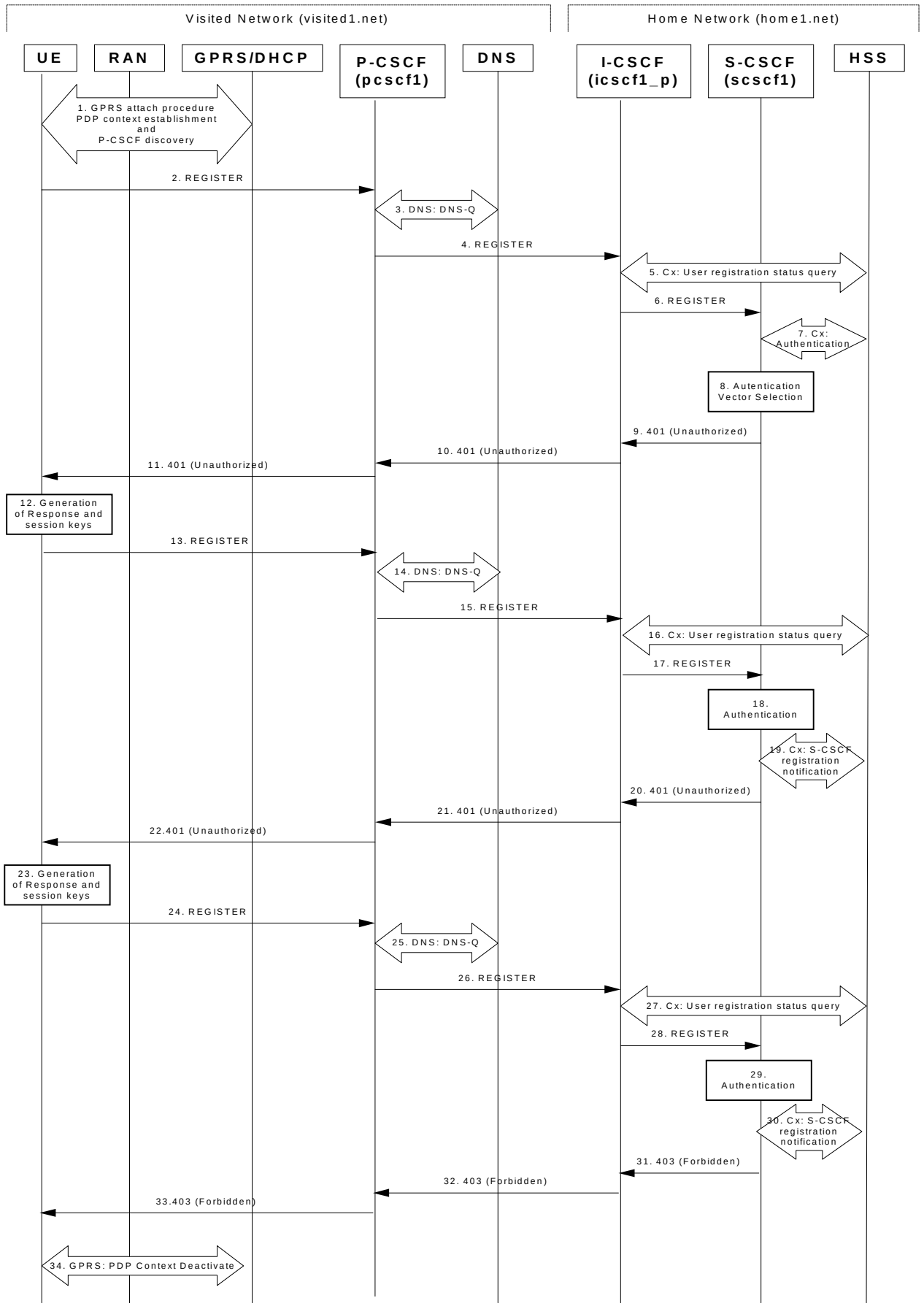

Figure 6.9.3-1: User authentication failure

Steps 1 through 17 are the same as the signalling flow in subclause 6.2.

18. **Authentication: User authentication fails**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active XRES matches the received RES. If the check is unsuccessful then this authentication challenge fails and the public user identity is not yet registered in the S-CSCF.

At this point the S-CSCF has the option of repeating a number of authentication challenges as given in step 18 through 28. For the purposes of this flow, only one repetition is shown.

19. **Cx. S-CSCF registration notification**

The S-CSCF selects new authentication vectors as specified in step 9, either from the list already within the S-CSCF, or by requesting new vectors from the HSS.

20. **401 (Unauthorized) response (S-CSCF to I-CSCF) - see example in table 6.9.3-20**

The authentication challenge is sent in the 401 (Unauthorized) response towards the UE.

Table 6.9.3-20: 401 (Unauthorized) response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd];branch=z9hG4bKnashds7
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server
                specific data), algorithm=AKAv1-MD5, ik="00112233445566778899aabbccddeeff",
                ck="ffeeddccbbaa11223344556677889900"
CSeq: 2 REGISTER
Content-Length: 0
```

NOTE: The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like: nonce="AY+3fUYo021Qi1Mnv3C6qAzEp4502"

21. **401 (Unauthorized) response (I-CSCF to P-CSCF) - see example in table 6.9.3-21**

The authentication challenge is sent in the 401 (Unauthorized) response towards the UE.

Table 6.9.3-21: 401 (Unauthorized) response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
     [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

22. **401 (Unauthorized) response (P-CSCF to UE) - see example in table 6.9.3-22**

The P-CSCF removes any keys received in the 401 (Unauthorized) response and forwards the rest of the response to the UE.

Table 6.9.3-22: 401 (Unauthorized) response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
From:
To:
Call-ID:
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server
   specific data), algorithm=AKAv1-MD5
Security-Server: ipsec-3gpp; q=0.1; alg=hmac-sha-1-96; spi=87654321; port1=7531
CSeq:
Content-Length:
```

WWW-Authenticate: The P-CSCF removes the ik and ck parameters (directives) from the header.

23. **Generation of response and session keys at UE**

Upon receiving the Unauthorised response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

24. **REGISTER request (UE to P-CSCF) - see example in table 6.9.3-24**

Table 6.9.3-24: REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>>;expires=7200
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="0a1b04c89e54f09ab45e84d30e29f83a"
Security-Verify: ipsec-3gpp; q=0.1; alg=hmac-sha-1-96; spi=87654321; port1=7531
CSeq: 3 REGISTER
Expires: 7200
Supported: path
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 12 along with the private user identity, the realm, the nonce, the URI and the algorithm.

25. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs the DNS queries to locate the I-CSCF in the home network. The look up in the DNS is based on the domain name specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port are not indicated, the P-CSCF performs an NAPTR query for the domain specified in the Request-URI.

Table 6.9.3-25a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [14].

Table 6.9.3-25b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net          0 IN NAPTR 50   50 "s" "SIP+D2U"    ""
     _sip._udp.registrar.home1.net
                      0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                             0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""
     _sips._tcp.registrar.home1.net
```

Since the UDP is prefered, the P-CSCF finds the I-CSCF by a DNS SRV lookup according to RFC 2782 [4].

Table 6.9.3-25c: DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 6.9.3-25d: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                     0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

26. **REGISTER request (P-CSCF to I-CSCF) - see example in table 6.9.3-26**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 6.9.3-26: REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
     [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info:
Max-Forwards: 69
Path: <sip:term@pcscf1.visited1.net;lr>
Require: path
P-Visited-Network-ID: "Visited Network Number 1"
P-Charging-Vector: icid-value=a834bc192fe3; icid-generated-at=[5555::e9e:d8d:c7c:b6b]
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
               nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
               uri="sip:registrar.home1.net", response="0a1b04c89e54f09ab45e84d30e29f83a",
               integrity-protected="yes"
CSeq:
Supported:
~~Expires:~~
Content-Length:
```

Path: This is the P-CSCF URI and is included to inform the S-CSCF ~~where to route terminating sessions~~where to route terminating requests.

27. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228 [11].

Table 6.9.3-27a provides the parameters in the REGISTER request (flow 5) which need to be sent to HSS.

Table 6.9.3-27a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER request	Description
I-CSCF to HSS	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	Public User Identity	To:	Identity which is used to communicate with other users
	Visited Network Identifier	P-Visited-Network-ID:	This information indicates the network identifier of the visited network

28. **REGISTER request (I-CSCF to S-CSCF) - see example in table 6.9.3-28**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 6.9.3-28: REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
     pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
     [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info:
Max-Forwards: 68
Path:
Require:
P-Visited-Network-ID:
P-Charging-Vector:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Supported:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path header and uses this URI for routeing mobile terminated sessions.

29. **Authentication**

Upon receiving the REGISTER request carrying the authentication response, RES, the S-CSCF checks that the user's active, XRES matches the received RES. If the check is unsuccessful, and no more authentication challenges are to be made, then the authentication has failed and the public user identity is not registered in the S-CSCF.

30. **Cx: S-CSCF registration notification procedure**

Upon user authentication failure the S-CSCF informs the HSS that the user has not been registered at this instance. The HSS clears the S-CSCF name for that subscriber.

For detailed message flows see 3GPP TS 29.229.

Table 6.9.3-30 provides the parameters in the REGISTER request (flow 18) which needs to be sent to HSS.

Table 6.9.3-30 Cx: S-CSCF registration notification procedure (S-CSCF to HSS)

Message source & destination	Cx Information element name	Information Source in REGISTER request	Description
S-CSCF to HSS	Public User Identify	To:	Identity which is used to communicate with other users
	Private User Identity	Authorization:	The Private User Identity is encoded in the username field according to the Authorization protocol.
	S-CSCF name	Request-URI:	This information indicates the serving CSCF's name of that user

31. **403 (Forbidden) response (S-CSCF to I-CSCF) - see example in table 6.9.3-31**

The S-CSCF sends an 403 (Forbidden) response to the I-CSCF indicating that authentication failed. No security parameters are included in this response.The S-CSCF will insert a warning header in the response, indicating to the UE the reason of refusing the Registration request. The Warning header will contain the name of the network inserting the warning header (warn-agent = home1.net) and in addition it may contain a warn-text.The warn-code inserted into the Warning header is 399.

Table 6.9.3-31: 403 (Forbidden) response (S-CSCF to I-CSCF)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
     pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
     [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Warning: 399 home1.net "Authentication failed"
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Call-ID: apb03a0s09dkjdfglkj49111
CSeq: 3 REGISTER
Content-Length: 0
```

32. **403 (Forbidden) response (I-CSCF to P-CSCF) - see example in table 6.9.3-32**

The I-CSCF forwards the 403 (Forbidden) response from the S-CSCF to the P-CSCF indicating that authentication was unsuccessful.

Table 6.9.3-32: 403 (Forbidden) response (I-CSCF to P-CSCF)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
     [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Warning: 399 home1.net "Authentication failed"
From:
To:
Call-ID:
CSeq:
Content-Length:
```

33. **403 (Forbidden) response (P-CSCF to UE) - see example in table 6.9.3-33**

The P-CSCF forwards the 403 (Forbidden) response to the UE.

Table 6.9.3-33: 403 (Forbidden) response (P-CSCF to UE)

```
SIP/2.0 403 Forbidden
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Warning: 399 home1.net "Authentication failed"
From:
To:
Call-ID:
CSeq:
Content-Length:
```

34. **PDP Context Deactivate**

On receiving the 403 (Forbidden) response the UE ceases registration and authentication attempts. In this case, if the PDP context on which the SIP signalling was being conducted is not being used for other purposes, the UE deactivates the signalling PDP context.

----------Next changes----------

16 Signalling flows for REGISTER (hiding)

16.1 Introduction

See subclause 6.1.

16.2 Registration signalling: user not registered

Figure 16.2-1 shows the registration signalling flow for the scenario when the user is not registered. For the purpose of this signalling flow, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network has network configuration hiding active.

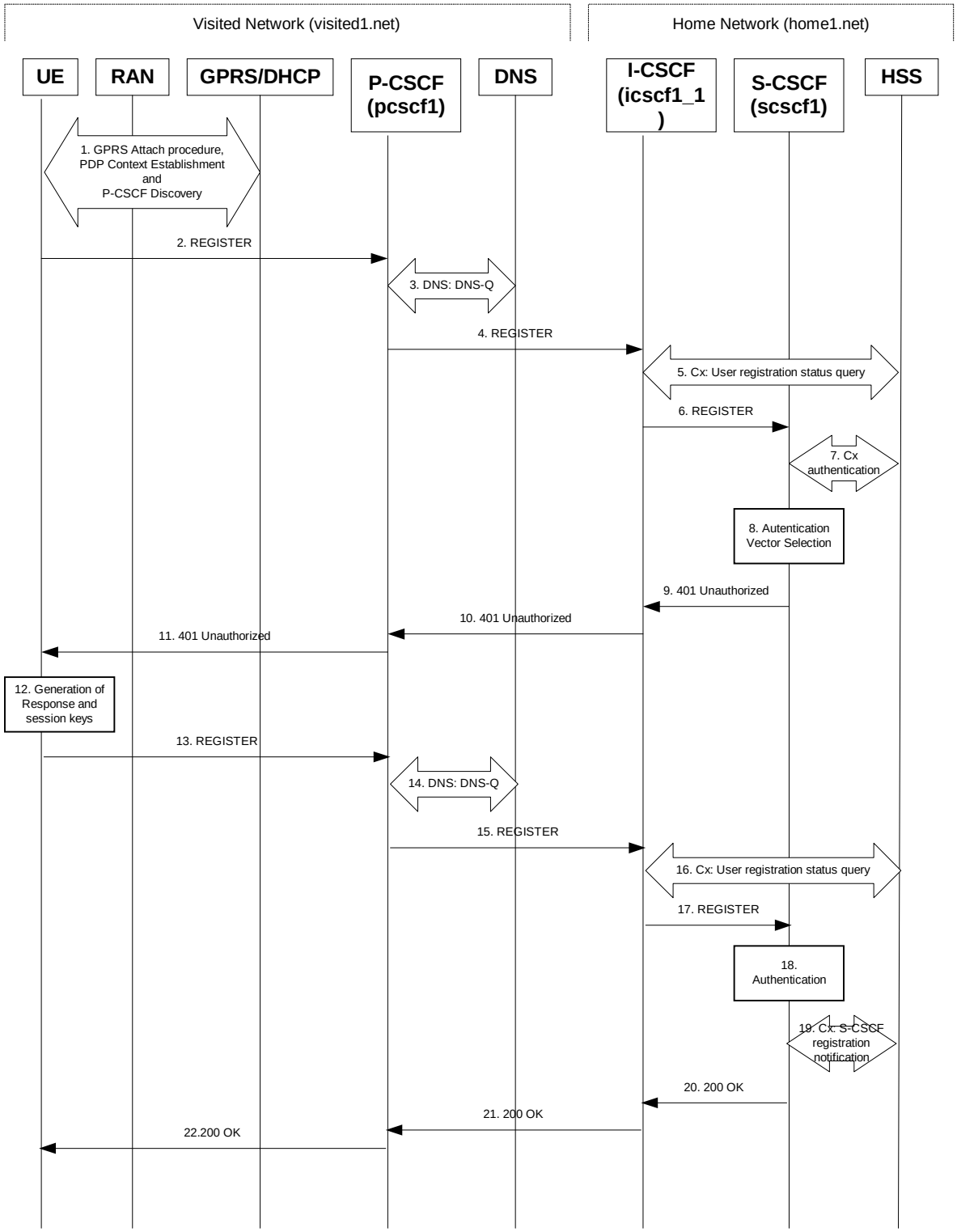

Figure 16.2-1: Registration when UE roaming

1. **GPRS Attach / PDP Context Establishment and P-CSCF Discovery (UE to GPRS)**

   This signalling flow is shown to indicate prerequisites for the registration signalling.

See subclause 5.2 for details.

2. **REGISTER request (UE to P-CSCF) – see example in table 16.2-2**

The purpose of this request is to register the user's SIP URI with a S-CSCF in the home network. This request is routed to the P-CSCF because it is the only SIP server known to the UE. ~~In the following SIP request, the Contact field contains the user's host address.~~

The P-CSCF will perform two actions, binding and forwarding. The binding is between the u~~U~~ser's SIP URI~~address~~ (<sip:user1_public1@home1.net>) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which was acquired during PDP context activation process.

Table 16.2-2 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 70
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11'
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd];comp=sigcomp>>;expires=7200
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce="", uri="sip:registrar.home1.net", response=""
Security-Client: ipsec-3gpp; alg=hmac-sha-1-96; spi=12345678; port1=1357
Require: sec-agree
Proxy-Require: sec-agree
CSeq: 1 REGISTER
Supported: path
Expires: 7200
Content-Length: 0
```

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("registrar.home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Via: IPv6 ~~PDP~~ address of ~~the SIP session~~UE allocated during the PDP Context Activation process.

Max-Forwards: Set to 70 by the UE and used to prevent loops.

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates the public user identity being registered. This is the identity by which other parties know this subscriber. It may be obtained from the USIM.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary point of contact for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF and S-CSCF.

~~Editor's note: It is for further study whether this information is stored in the HSS and the S-CSCF for the subscriber in order to support multiple registrations.~~

Authorization: It carries authentication information. The private user identity (user1_private@home1.net) is carried in the username field of the Digest AKA protocol. The uri parameter (directive) contains the same value as the Request-URI. The realm parameter (directive) contains the network name where the username is authenticated. The Request-URI and the realm parameter (directive) value are obtained from the same field in the USIM, and therefore, are identical. In this example, it is assumed that a new UICC card was just inserted into the terminal, and there is no other cached information to send. Therefore, nonce and response parameters (directives) are empty.

Security-Client: Lists the supported algorithm(s) by the UE.

Supported: This header is included to indicate to the recipient that the UE supports the Path header.

P-Access-Network-Info: the UE provides the access-type and access-info, related to the serving access network as specified in sub-clause ' Additional coding rules for P-Access-Network-Info header', in 3GPP TS 24.229 [16].

Upon receiving this request the P-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

3. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs the DNS queries to locate the I-CSCF in the home network. The look up in the DNS is based on the domain name specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port are not indicated, the P-CSCF performs an NAPTR query for the domain specified in the Request-URI.

Table 16.2-3a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [14].

Table 16.2-3b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net          0 IN NAPTR 50   50 "s" "SIP+D2U"    ""
     _sip._udp.registrar.home1.net
                     0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                          0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""
     _sips._tcp.registrar.home1.net
```

Based on the order and preference of the NAPTR record and the local preference, UDP is preferred and the P-CSCF finds the I-CSCF by a DNS SRV lookup according to RFC 2782 [4].

Table 16.2-3c DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 16.2-3d DNS: DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.com
                                     0 IN SRV 1  0 5060 icscf7_p.home1.com

icscf1_p.home1.net                       0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                       0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority

and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

4. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.2-4**

The P-CSCF needs to be in the path for all terminating requests for this user. To ensure this, the P-CSCF adds itself to the path for future requests.

The P-CSCF binds the public user identity under registration to the Contact header supplied by the user.

The P-CSCF adds also the P-Visited-Network-ID header with the contents of the identifier of the P-CSCF network. This may be the visited network domain name or any other identifier that identifies the visited network at the home network.

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.2-4 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 69
P-Access-Network-Info:
Path: <sip:term@pcscf1.visited1.net;lr>
Require: path
P-Visited-Network-ID: "Visited Network Number 1"
P-Charging-Vector: icid-value=a834bc192fe3; icid-generated-at=[5555::e9e:d8d:c7c:b6b]
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce="", uri="sip:registrar.home1.net", response="", integrity-protected="no"
CSeq:
Supported:
~~Expires:~~
Content-Length:
```

Path: This is the address of the P-CSCF and is included to inform the S-CSCF ~~where to route terminating sessions~~where to route terminating requests.

Require: This header is included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

P-Visited-Network-ID: It contains the identifier of the P-CSCF network at the home network.

P-Access-Network-Info: this header contains information from the UE.

5. **Cx: User registration status query procedure**

The I-CSCF makes a request for information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-5a provides the parameters in the REGISTER request (flow 4) which need to been sent to HSS.

6. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.2-6**

I-CSCF adds a proper I-CSCF URI to the Path header.

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 16.2-6 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 68
P-Access-Network-Info:
Path: <sip:icscf1_p.home1.net;lr>, <sip:term@pcscf1.visited1.net;lr>
Require:
P-Visited-Network-ID:
P-Charging-Vector:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Supported: path
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path header and uses these URIs ~~for routing mobile terminated sessions~~for routing mobile terminated requests.

Upon receiving this request the S-CSCF will set it's SIP registration timer for this UE to the Expires time in this request.

7. **Cx: S-CSCF authentication procedure**

As the REGISTER request arrived without integrity protection to the P-CSCF, the S-CSCF shall challenge it. For this, the S-CSCF requires at least one authentication vector to be used in the challenge to the user. If a valid AV is not available, then the S-CSCF requests at least one AV from the HSS.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-7a provides the parameters in the REGISTER request (flow 6) which need to be sent to HSS.

8. **Authentication vector selection**

The S-CSCF selects an authentication vector for use in the authentication challenge. For detailed description of the authentication vector, see 3GPP TS 33.203.

NOTE 1: The authentication vector may be of the form 3GPP TS 33.203 (if IMS AKA is the selected authentication scheme):

$AV = RAND_n||AUTN_n||XRES_n||CK_n||IK_n$ where:

- RAND: random number used to generate the XRES, CK, IK, and part of the AUTN. It is also used to generate the RES at the UE.
- AUTN: Authentication token (including MAC and SQN).
- XRES: Expected (correct) result from the UE.
- CK: Cipher key (optional).
- IK: Integrity key.

9. **401 Unauthorized response (S-CSCF to I-CSCF) – see example in table 16.2-9**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.2-9: 401 Unauthorized response (S-CSCF to I-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
From:
To: <sip:user1_public1@home1.net>;tag=5ef4
Call-ID:
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server
   specific data), algorithm=AKAv1-MD5, ik="00112233445566778899aabbccddeeff",
   ck="ffeeddccbbaa11223344556677889900"
CSeq:
Content-Length:
```

WWW-Authenticate: The S-CSCF challenges the user. The nonce includes the quoted string, base64 encoded value of the concatenation of the AKA RAND, AKA AUTN and server specific data. The S-CSCF appends also the Integrity Key (IK) and the Cyphering key (CK).

NOTE: The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like: nonce="A34Cm+Fva37UYWpGNB34JP"

10. **401 Unauthorized response (I-CSCF to P-CSCF) – see example in table 16.2-10**

The authentication challenge is sent in the 401 Unauthorized response towards the UE.

Table 16.2-10: 401 Unauthorized response (I-CSCF to P-CSCF)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
From:
To:
Call-ID:
WWW-Authenticate:
CSeq:
Content-Length:
```

11. **401 Unauthorized response (P-CSCF to UE) – see example in table 16.2-11**

The P-CSCF removes any keys received in the 401 Unauthorized response and forwards the rest of the response to the UE.

Table 16.2-11: 401 Unauthorized response (P-CSCF to UE)

```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
From:
To:
Call-ID:
WWW-Authenticate: Digest realm="registrar.home1.net", nonce=base64(RAND + AUTN + server
   specific data), algorithm=AKAv1-MD5
Security-Server: ipsec-3gpp; q=0.1; alg=hmac-sha-1-96; spi=87654321; port1=7531
CSeq:
Content-Length:
```

WWW-Authenticate: The P-CSCF removes the ik and ck parameters (directives) from the header.

12. **Generation of response and session keys at UE**

Upon receiving the Unauthorized response, the UE extracts the MAC and the SQN from the AUTN. The UE calculates the XMAC and checks that XMAC matches the received MAC and that the SQN is in the correct range. If both these checks are successful the UE calculates the response, RES, and also computes the session keys IK and CK. The RES is put into the Authorization header and sent back to the registrar in the REGISTER request.

13. **REGISTER request (UE to P-CSCF) – see example in table 16.2-13**

Table 16.2-13 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 70
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>>;expires=7200
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1"
Security-Verify: ipsec-3gpp; q=0.1; alg=hmac-sha-1-96; spi=87654321; port1=7531
CSeq: 2 REGISTER
Supported: path
Expires: 7200
Content-Length: 0
```

Authorization: This carries the response to the authentication challenge received in step 11 along with the private user identity , the realm, the nonce, the URI and the algorithm.

14. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs the DNS queries to locate the I-CSCF in the home network. The look up in the DNS is based on the domain name specified in the Request URI.

The P-CSCF sends the REGISTER request - after local processing - to the address indicated in the Request-URI. When forwarding the REGISTER request the P-CSCF needs to specify the protocol, port number and IP address of the I-CSCF server in the home network to which to send the REGISTER request. The P-CSCF tries to find this information by querying the DNS. Since the Request-URI does not specify a numeric IP address, and the transport protocol and port are not indicated, the P-CSCF performs an NAPTR query for the domain specified in the Request-URI.

Table 16.2-14a DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=registrar.home1.net, QCLASS=IN, QTYPE=NAPTR
```

The DNS records are retrieved according to RFC 3263 [14].

Table 16.2-14b DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=registrar.home1.net,  QCLASS=IN, QTYPE=NAPTR

registrar.home1.net          0 IN NAPTR 50   50 "s" "SIP+D2U"    ""
     _sip._udp.registrar.home1.net
                    0 IN NAPTR 90   50 "s" "SIP+D2T"    ""  _sip._tcp.registrar.home1.net
                               0 IN NAPTR 100  50 "s" "SIPS+D2T"   ""
     _sips._tcp.registrar.home1.net
```

Based on the order and preference of the NAPTR record and the local preference, UDP is preferred and the P-CSCF finds the I-CSCF by a DNS SRV lookup according to RFC 2782 [4].

Table 16.2-14c DNS: DNS Query (P-CSCF to DNS)

```
OPCODE=SQUERY
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV
```

The DNS records are retrieved according to RFC 2782 [4].

Table 16.2-14d DNS Query Response (DNS to P-CSCF)

```
OPCODE=SQUERY, RESPONSE, AA
QNAME=__sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_sip._udp.registrar.home1.net        0 IN SRV 1 10 5060 icscf1_p.home1.net
                                     0 IN SRV 1  0 5060 icscf7_p.home1.net

icscf1_p.home1.net                 0 IN AAAA     5555::aba:dab:aaa:daa
icscf7_p.home1.net                 0 IN AAAA     5555::a1a:b2b:c3c:d4d
```

In the Answer field of the query-response each I-CSCF is identified by its host domain name. The returned SRV Resource Records (RRs) are merged and ordered, and the selection technique (employing the Priority and Weight parameters returned in the RRs) as specified in RFC 2782 [4] is used to select the I-CSCF (i.e. the icscf1_p.home1.net). Since the Additional Data field of the query-response also contains the IP address of the selected I-CSCF (i.e. 5555::aba:dab:aaa:daa), a new query to the DNS is not required.

Once the IP address of the I-CSCF is obtained, the P-CSCF forwards the REGISTER request to this IP address (i.e. 5555::aba:dab:aaa:daa) using the UDP protocol and port number 5060.

15. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.2-15**

This signalling flow shows the REGISTER request being forwarded from the P-CSCF to the I-CSCF in the home domain.

Table 16.2-15 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 69
P-Access-Network-Info:
Path: <sip:term@pcscf1.visited1.net;lr>
Require: path
P-Visited-Network-ID: "Visited Network Number 1"
P-Charging-Vector: icid-value=a834bc192fe3; icid-generated-at=[5555::e9e:d8d:c7c:b6b]
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-
   protected="yes"
CSeq:
Supported:
~~Expires:~~
Content-Length:
```

Path: This is the P-CSCF URI and is included to inform the S-CSCF ~~where to route terminating sessions~~where to route terminating requests.

16. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. The HSS returns the S-CSCF required capabilities and the I-CSCF uses this information to select a suitable S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-16a provides the parameters in the REGISTER request (flow 15) which need to been sent to HSS.

17. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.2-17**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.2-17 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;;branch=z9hG4bKnashds7
Max-Forwards: 68
P-Access-Network-Info:
Path: <sip:icscf1_p.home1.net;lr>, <sip:term@pcscf1.visited1.net;lr>
Require:
P-Visited-Network-ID:
P-Charging-Vector:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Supported:
Expires:
Content-Length:
```

Path: The I-CSCF adds an I-CSCF(THIG) to the list of URIs in the Path header. The S-CSCF stores the contents of the Path headers and uses these addresses ~~for routing mobile terminated sessions~~for routing mobile terminated requests.

18. **Authentication**

Upon receiving an integrity protected REGISTER request, carrying the authentication response, RES, the S-CSCF checks that the user's active XRES matches the received RES. If the check is successful then the user has been authenticated and the public user identity is registered in the S-CSCF.

19. **Cx: S-CSCF registration notification procedure**

On registering a user the S-CSCF informs the HSS that the user has been registered at this instance. The HSS stores the S-CSCF name for that subscriber. For a positive response, the HSS will include the user profile in the response sent to the S-CSCF.

For detailed message flows see 3GPP TS 29.228.

Table 6.2-19a provides the parameters in the SIP REGISTER request (flow 17) which need to been sent to HSS.

20. **200 OK response (S-CSCF to I-CSCF) – see example in table 16.2-20**

The S-CSCF sends a 200 (OK) response to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.2-20 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path: <sip:icscf1_p.home1.net;lr>, <sip:term@pcscf1.visited1.net;lr>
Service-Route: <sip:icscf1_p.home1.net;lr>,
   <sip:scscf1.home1.net:1481orig@scscf1.home1.net;lr>
From:
To:
Call-ID:
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>>;expires=7200;expires=7200
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
P-Associated-URI: <sip:user1_public2@home1.net>, <sip:user1_public3@home1.net>, <sip:+1-212-
   555-1111@home1.net;user=phone>
Content-Length:
```

Service-Route: The S-CSCF inserts the Service-Route header that includes its own URI including a port number to differentiate mobile originating requests from mobile terminating requests.~~**Service-Route:** The~~

~~S-CSCF inserts the Service-Route header value that includes an I-CSCF (THIG) and the own S-CSCF URI.~~

21. **200 OK response (I-CSCF to P-CSCF) – see example in table 16.2-21**

The I-CSCF translates the S-CSCF name in the Service-Route header. The I-CSCF forwards the 200 (OK) response from the S-CSCF to the P-CSCF indicating that the ~~R~~registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.2-21 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route: <sip:icscf1_p.home1.net;lr>,
   <sip:token(~~scscf1.home1.net:1481~~orig@scscf1.home1.net;lr)@home1.net;tokenized-by=home1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
P-Associated-URI:
Content-Length:
```

22. **200 OK response (P-CSCF to UE) – see example in table 16.2-22**

The P-CSCF saves the value of the Service-Route header and associates it with the UE. The P-CSCF then forwards the 200 (OK) response from the I-CSCF to the UE indicating th~~at~~e ~~R~~registration was successful.

Table 16.2-22 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route:
From:
To:
Call-ID:
Contact:
CSeq:
Date:
P-Associated-URI:
Content-Length:
```

16.3 Registration signalling: reregistration – user currently registered

For the purpose of the reregistration signalling flow shown in figure 16.3-1, the subscriber is considered to be roaming. This flow also shows the authentication of the private user identity. In this signalling flow, the home network has network configuration hiding active.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for reregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 is completed first.

~~Editor's Note: If the same PDP Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?2. The DHCP procedure employed for P-CSCF discovery is not needed.~~

2. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

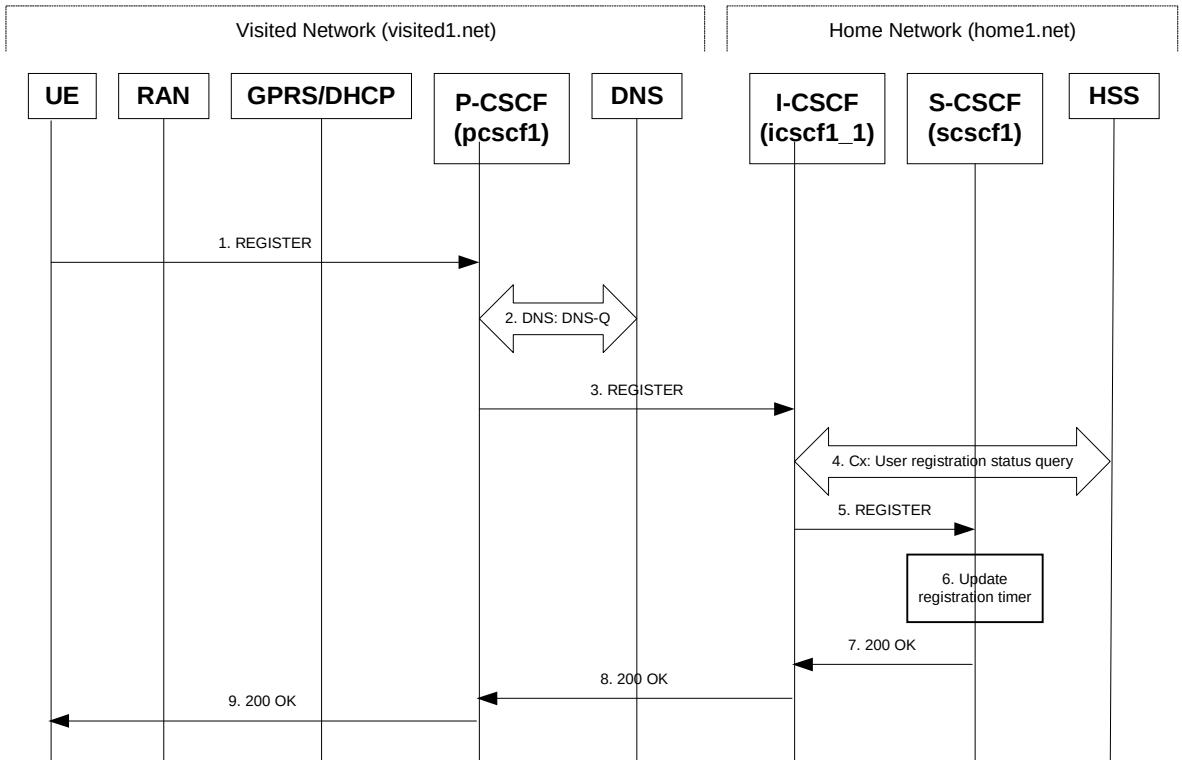

Figure 16.3-1: Reregistration when UE roaming

1. **REGISTER request (UE to P-CSCF) – see example in table 16.3-1**

   The registration expires in the UE. The UE reregisters by sending a new REGISTER request. This request is sent to the same P-CSCF with which the UE initially registered. The P-CSCF maintains the same binding between the User's SIP public address (user1_public1@home1.net) and the host (terminal) address ([5555::aaa:bbb:ccc:ddd]) which it established during the original registration.

Table 16.3-1 REGISTER request (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;;branch=z9hG4bKnashds7
Max-Forwards: 70
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>>;expires=7200
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1"
Security-Client: ipsec-3gpp; alg=hmac-sha-1-96; spi=12345678; port1=1357
Required: sec-agree
CSeq: 3 REGISTER
Supported: path
~~Expires: 7200~~
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity being registered. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being registered. Subsequent requests destined for this subscriber will be sent to this address. This information is stored in the P-CSCF.

~~Editor's note: It is for further study whether this information is stored in the HSS and the S-CSCF for the subscriber in order to support multiple registrations.~~

Authorization: It carries authentication information. The private user identity (user1_private@home1.net) is carried in the username field of the Digest AKA protocol. As this is a re-registration process, the cached information (realm, nonce, algorithm, uri, response) is also sent.

NOTE 1: The actual nonce value in the WWW-Authenticate header field is encoded in base64, and it may look like: nonce="A34Cm+Fva37UYWpGNB34JP"

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Supported: This header is included to indicate to the recipient that the UEsupports the Path header.

Upon receiving this request the P-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

2. **DNS: DNS-Q**

Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs the DNS queries to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.3-3**

This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.3-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info:
Max-Forwards: 69
Path: <sip:term@pcscf1.visited1.net;lr>
Require: path
P-Visited-Network-ID: "Visited Network Number 1"
P-Charging-Vector: icid-value=a834bc192fe3; icid-generated-at=[5555::e9e:d8d:c7c:b6b]
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-
   protected="yes"
CSeq:
Supported: path
~~Expires:~~
Content-Length:
```

Path: This is the P-CSCF URI and is included to inform the S-CSCF ~~where to route terminating sessions~~where to route terminating requests.

Require: This header is included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

P-Visited-Network-ID: It contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber

For detailed message flows see 3GPP TS 29.228.

For the parameters in the REGISTER request (flow 3), which are sent to the HSS, see table 6.2-5a.

Table 6.3-4a provides the parameters in the SIP REGISTER request (flow 5), which are obtained from the information sent back from the HSS.

5. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.3-5**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

I-CSCF adds a proper I-CSCF name to the Path header.

Table 16.3-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info:
Max-Forwards: 68
Path: <sip:icscf1_p.home1.net;lr>, <sip:term@pcscf1.visited1.net;lr>
Require:
P-Visited-Network-ID:
P-Charging-Vector:
From:
To:
Contact:
Authorization:
Call-ID:
CSeq:
Supported:
~~Expires:~~
Content-Length:
```

Path: The S-CSCF stores the contents of the Path header and uses these URIs ~~for routing mobile terminated sessions~~for routing mobile terminated requests.

P-Visited-Network-ID: It contains the identifier of the P-CSCF network at the home network.

Upon receiving this request the S-CSCF will detect that it already has a registration record for this UE and will reset it's SIP registration timer for this UE to the Expires time in this request.

6. **Update registration timer**

As the REGISTER request arrived integrity protected, the S-CSCF does not need to challenge the user, but just update the registration timer to the value requested by the user (if the policy of the network allows it).

NOTE: The S-CSCF is allowed to challenge the user. If S-CSCF decides to challenge the user, the call flow will be similar to the one presented in section 16.2.

7. **200 OK response (S-CSCF to I-CSCF) – see example in Table 16.3-7**

The S-CSCF sends a 200 (OK) response to the I-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.3-7 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path: <sip:icscf1_p.home1.net;lr>, <sip:term@pcscf1.visited1.net;lr>
Service-Route: <sip:icscf1_p.home1.net;lr>,
   <sip:scscf1.home1.net:1481orig@scscf1.home1.net;lr>
From:
To:
Call-ID:
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=7200Contact:
   <sip:[5555::aaa:bbb:ccc:ddd]>;expires=7200
CSeq:
Date: Wed, 11 July 2001 08:49:37 GMT
P-Associated-URI: <sip:user1_public2@home1.net>, <sip:user1_public3@home1.net>, <sip:+1-212-
   555-1111@home1.net;user=phone>
Content-Length:
```

Service-Route: The S-CSCF inserts the Service-Route header value that includes a~~n~~URI of an I-CSCF (THIG) and its own URI including a port number to differentiate mobile originating requests from mobile terminating requests~~the own S-CSCF URI~~.

8. **200 OK response (I-CSCF to P-CSCF) – see example in Table 16.3-8**

   The I-CSCF translates the S-CSCF name in the Service-Route header. The I-CSCF forwards the 200 (OK) response from the S-CSCF to the P-CSCF indicating that Registration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.3-8 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route: <sip:icscf1_p.home1.net;lr>,
   <sip:token(scscf1.home1.net;lr)@home1.net;tokenized-by=home1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
P-Associated-URI:
Content-Length:
```

9. **200 OK response (P-CSCF to UE) – see example in Table 16.3-9**

   The P-CSCF saves the value of the Service-Route header and associates it with the UE. The P-CSCF then forwards the 200 (OK) response from the I-CSCF to the UE indicating th~~at R~~e registration was successful.

Table 16.3-9 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route:
From:
To:
Call-ID:
Contact:
CSeq:
Date:
P-Associated-URI:
Content-Length:
```

16.4 Registration signalling: mobile initiated deregistration

Figure 16.4-1 shows a signalling flow for mobile initiated deregistration. For the purposes of this deregistration signalling flow, the subscriber is considered to be roaming. In this signalling flow, the home network has configuration hiding active.

This signalling flow assumes:

1. That the same PDP Context allocated during the initial registration scenario is still used for deregistration. For the case when the UE does not still have an active PDP context then PDP context procedures from subclause 16.2 must first be completed.

~~Editor's Note: If the same PDP Context is not available, is it guaranteed that the UE will get back the same IP address at this point? If this is not possible, would there be a problem with the binding in the P-CSCF (user_public1@home1.net and [5555::aaa:bbb:ccc:ddd])?~~

2. The procedure employed for P-CSCF discovery is not needed.

3. The S-CSCF selection procedure invoked by the I-CSCF is not needed.

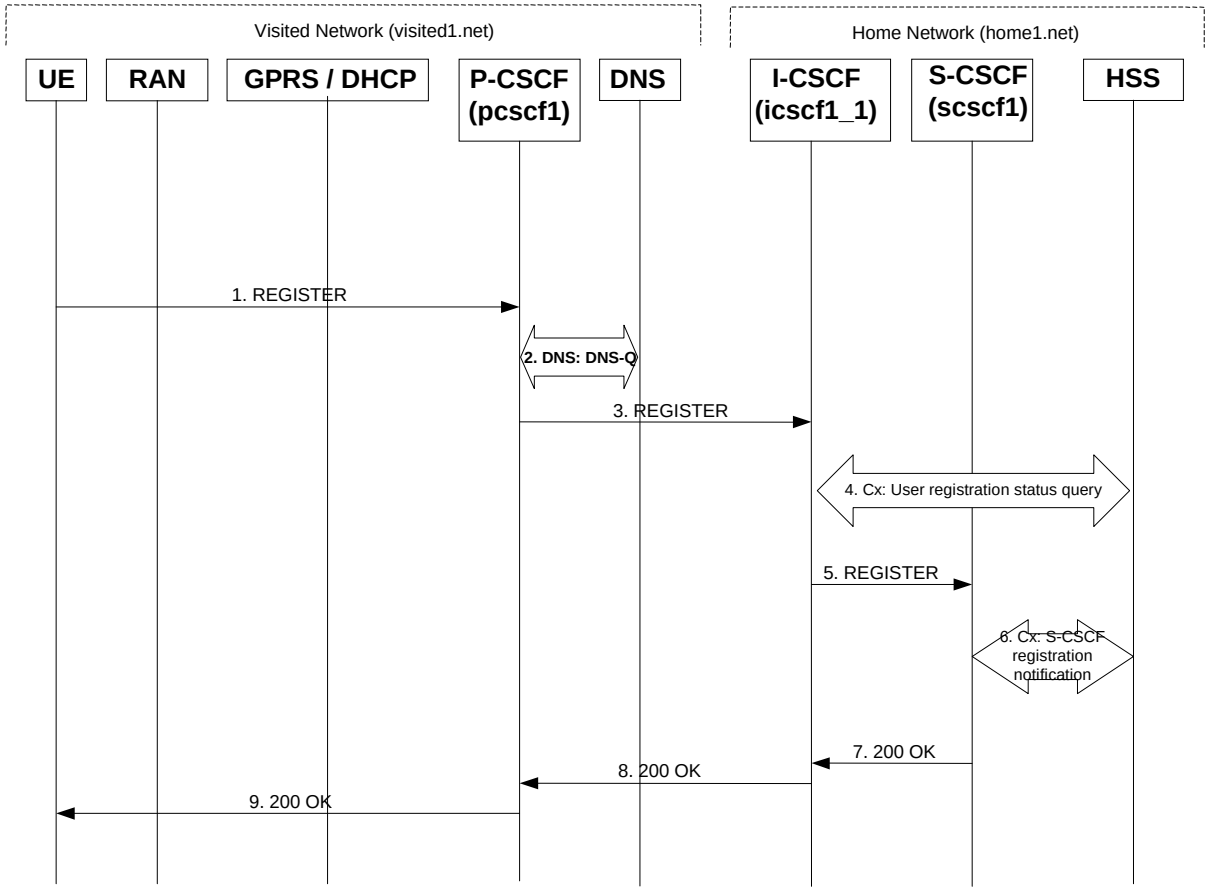

Figure 16.4-1: Registration signalling: mobile initiated deregistration

1. **REGISTER request (UE to P-CSCF) – see example in table 16.4-1**

   The UE intends to de-register itself. It does so by sending a new REGISTER request. This request looks similar as in reregister case, but the Expires header contains zero. This request is sent to the same P-CSCF with which the UE initially registered.

Table 16.4-1 REGISTER (UE to P-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
Max-Forwards: 70
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>>;expires=7200
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1"
CSeq: 7 REGISTER
Supported: path
Expires: 0
Content-Length: 0
```

The header field usage is the same as for the initial registration scenario:

From: This indicates the public user identity originating the REGISTER request. The public user identity may be obtained from the USIM.

To: This indicates public user identity. This is the identity by which other parties know this subscriber.

Contact: This indicates the point-of-presence for the subscriber – the IP address of the UE. This is the temporary identifier for the subscriber that is being de-registered.

Authorization: It carries authentication information. The private user identity is carried in the usernamed field of the Digest AKA protocol. The deregistration process also includes the cached information (realm, nonce, algorithm, uri, response).

Request-URI: The Request-URI (the URI that follows the method name, "REGISTER", in the first line) indicates the destination domain of this REGISTER request. The rules for routing a SIP request describe how to use DNS to resolve this domain name ("home1.net") into an address or entry point into the home operator's network (the I-CSCF). This information is stored in the USIM.

Expires: The 0 value indicates the registration is being cancelled.

Supported: This header is included to indicate to the recipient that the UE supports the Path header.

Upon receiving this request the P-CSCF will reset the SIP registration timer for this UE to 0.

2. **DNS: DNS-Q**

   Based on the user's URI, the P-CSCF determines that UE is registering from a visiting domain and performs a DNS query to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI. The DNS provides the P-CSCF with an address of the I-CSCF in the home network. The P-CSCF must not use the I-CSCF address cached as a result of the previous registration.

3. **REGISTER request (P-CSCF to I-CSCF) – see example in table 16.4-3**

   This signalling flow shows the REGISTER request being forward from the P-CSCF to the I-CSCF in the home domain.

Table 16.4-3 REGISTER request (P-CSCF to I-CSCF)

```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info:
Max-Forwards: 69
Path: <sip:term@pcscf1.visited1.net;lr>
Require: path
P-Visited-Network-ID: "Visited Network Number 1"
From:
To:
Contact:
Call-ID:
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registrar.home1.net", response="6629fae49393a05397450978507c4ef1", integrity-
   protected="yes"
CSeq:
Supported:
Expires:
Content-Length:
```

Path: This is the P-CSCF URI and is included to inform the S-CSCF ~~where to route terminating sessions~~where to route terminating requests.

Require: This header is included to ensure that the recipient correctly handles the Path header. If the recipient does not support the path header, a response will be received with a status code of 420 and an Unsupported header indicating "path". Such a response indicates a misconfiguration of the routing tables and the request has been routed outside the IM CN subsystem.

P-Visited-Network-ID: It contains the identifier of the P-CSCF network at the home network.

4. **Cx: User registration status query procedure**

   The I-CSCF requests information related to the Subscriber registration status by sending the private user identity, public user identity and visited domain name to the HSS. Because the user has registered, the HSS returns the I-CSCF with the S-CSCF address for the subscriber

   For detailed message flows see 3GPP TS 29.228.

   For the parameters in the SIP REGISTER request (flow 3) which are sent to the HSS, see table 6.2-5a.

   Table 6.3-4a provides the parameters in the SIP REGISTER request (flow 5) which are obtained from the information sent back from the HSS.

5. **REGISTER (I-CSCF to S-CSCF) – see example in table 16.4-5**

   I-CSCF adds a proper I-CSCF name to the Path header.

   This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

Table 16.4-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info:
Max-Forwards: 68
Path: <sip:icscf1_p.home1.net;lr> <sip:term@pcscf1.visited1.net;lr>
Require:
P-Visited-Network-ID:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Supported:
Expires:
Content-Length:
```

Upon receiving this request the S-CSCF will reset the SIP registration timer for this UE to 0.

6. **Cx: S-CSCF registration notification procedure**

   The S-CSCF informs the HSS that the user is no longer registered and the S-CSCF either notifies the HSS to clear or requests to keep its location information for that subscriber. The HSS then either clears or keeps the S-CSCF name for that subscriber according to request. In both cases the state of the subscriber identity is stored as unregistered in the HSS and the S-CSCF. The HSS acknowledges the request.

   For detailed message flows see 3GPP TS 29.228.

   For the parameters in the SIP REGISTER request (flow 5), which are sent to the HSS, see table 6.2-7a.

7. **200 OK (S-CSCF to I-CSCF) – see example in table 16.4-7**

   The S-CSCF sends a 200 (OK) response to the I-CSCF indicating that deregistration was successful. This request will traverse the path that the REGISTER request took as described in the Via list. The S-CSCF clears its information for that subscriber.

Table 16.4-7 200 OK response (S-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path: <sip:icscf1_p.home1.net;lr>, <sip:term@pcscf1.visited1.net;lr>
Service-Route: <sip:icscf1_p.home1.net;lr>,
   <sip:scscf1.home1.net:1481orig@scscf1.home1.net;lr>
From:
To: <sip:user1_public1@home1.net>
Call-ID: apb03a0s09dkjdfglkj49111
Contact:
   <sip:[5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=0>;expires=0
CSeq: 3 REGISTER
Date: Wed, 11 July 2001 08:49:37 GMT
P-Associated-URI: <sip:user1_public2@home1.net>, <sip:user1_public3@home1.net>, <sip:+1-212-
   555-1111@home1.net;user=phone>
Content-Length: 0
```

8. **200 OK (I-CSCF to P-CSCF) – see example in table 16.4-8**

   The I-CSCF forwards the 200 (OK) response from the S-CSCF to the P-CSCF indicating that deregistration was successful. This response will traverse the path that the REGISTER request took as described in the Via list.

Table 16.4-8 200 OK response (I-CSCF to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route: <sip:icscf1_p.home1.net;lr>,
   <sip:token(scscf1.home1.net;lr)@home1.net;tokenized-by=home1.net>
From:
To:
Call-ID:
Contact:
CSeq:
Date:
P-Associated-URI:
Content-Length:
```

9. **200 OK (P-CSCF to UE) – see example in table 16.4-9**

   The P-CSCF forwards the 200 (OK) response from the I-CSCF to the UE indicating that deregistration was successful. The P-CSCF clears its information for that subscriber after sending the acknowledgement to the UE.

Table 16.4-9 200 OK response (P-CSCF to UE)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Path:
Service-Route:
From:
To:
Call-ID:
Contact:
CSeq:
Date:
P-Associated-URI:
Content-Length:
```

16.5 UE subscription for the registration state event package

This section describes the subscription procedure for the registration states event package, whereby the UE requests to be notified by the S-CSCF when the event has occurred. This is done using the information structure as indicated in 3GPP TS 24.229 [16].

It is assumed that the user has registered prior to initiating subscription of an event. Also, the subscriber is considered to be roaming and the home network has network configuration hiding active. For this example the trigger point at the UE for sending out the SUBSCRIBE request is the 200 (OK) response of the user's registration.

Editor's Note: The interaction between the explicit subscription procedure for the `Event: reg event package` and the registration procedures needs further consideration. For example: What are the appropriate timer values of Expires header for these procedures considering the signalling is over the radio interface? What is the status of the ongoing explicit subscription procedure (`Event: reg event package`) when the registration timer has expired? etc.

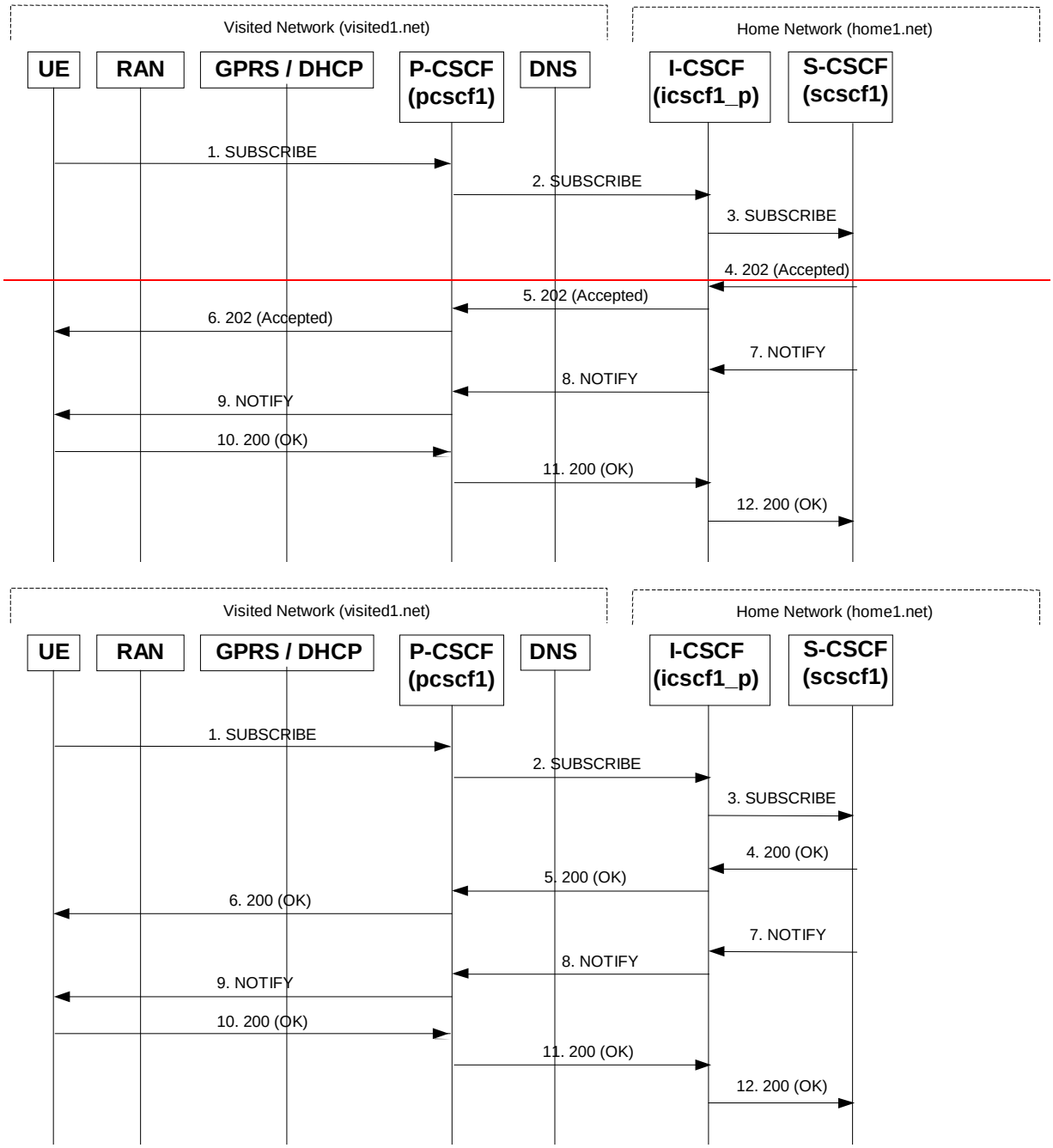

Figure 16.5-1: UE subscription for the registration state event package (with I-CSCF providing configuration independence)

1. **SUBSCRIBE request (UE to P-CSCF) – see example in table 16.5-1**

   The UE generates a SUBSCRIBE request in order to subscribe for the reg event package.

   The From and To fields both will contain the UE's public address.

Table 16.5-1 SUBSCRIBE request (UE to P-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 70
Route: <sip:pcscf1.visited1.net:7531;lr;comp=sigcomp>,
   <sip:scscf1.home1.net:1481orig@scscf1.home1.net;lr>
P-Preferred-Identity: "John Doe" <sip:user1_public1@home1.net>
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11P-Asserted-Identity:
   "John Doe" <sip:user1_public1@home1.net>
Privacy: none
From: <sip:user1_public1@home1.net>;tag=31415
To: <sip: user1_public1@home1.net>
Call-ID: b89rjhnedlrfjflslj40a222
Require: sec-agree
Proxy-Require: sec-agree
CSeq: 61 SUBSCRIBE
Event: reg
Expires: 7200
Accept: application/cpim-pidf+xml
Security-Verify: ipsec-3gpp; q=0.1; alg=hmac-sha-1-96; spi=87654321; port1=7531
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=7200Contact:
   <sip:[5555::aaa:bbb:ccc:ddd]>
Content-Length: 0
```

Request URI: Public user identity whose events the subscriber subscribes to. In this case the subscribing user and the monitored user are identical.

From: This field is populated with logical representation (FQDN) for the entity sending the SUBSCRIBE request.

Privacy: The user does not require privacy, therefore the Privacy header is set to the value “none” as specified in RFC 3323 [13].

Route: contains the P-CSCF address learnt during P-CSCF discovery, plus the elements from the Service-Route header from registration. The P-CSCF URI contains the port number learnt during the security agreement negotiation.

P-Preferred-Identity: The user provides a hint about the identity to be used for this dialog.

P-Access-Network-Info: the UE provides the access-type and access-info, related to the serving access network as specified in sub-clause ' Additional coding rules for P-Access-Network-Info header', in 3GPP TS 24.229 [16].**Privacy:**the user does not require privacy, therefore the Privacy header is set to the value “none” as specified in draft-ietf-sip-asserted-identity [17] and draft-ietf-sip-privacy-general [13].

P-Asserted-Identity: the user provides a hint about the identity to be used for this session.

Event: This field is populated with the value 'reg' to specify the use of the presence package.

Accept: This field is populated with the value 'application/cpim-pidf+xml'.

To: Same as the Request-URI.

Contact: The contact information of the subscribing user.

Upon receiving the SUBSCRIBE request, the P-CSCF stores the following information about this dialog, for use in possible error recovery actions - see example in table 16.5-1b.

Table 16.5-1b: Storage of information at P-CSCF

```
Request-URI: sip:user1_public1@home1.net
From: <sip:user1_public1@home1.net>;tag=31415
To: <sip:user1_public@home1.net>
Call-ID: b89rjhnedlrfjflslj40a222
Cseq(2dest): 61 SUBSCRIBE
Cseq(2orig): none
Route(2dest): <sip:scscf1.home1.net:1481orig@scscf1.home1.net;lr>
Contact(orig): <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=7200Request-URI:
 sip:user1_public1@home1.net
From: sip:user1_public1@home1.net;tag=31415
To: sip:user1_public@home1.net
Call-ID: b89rjhnedlrfjflslj40a222
Cseq(2dest): 61 SUBSCRIBE
Cseq(2orig): none
Contact(orig): sip:[5555::aaa:bbb:ccc:ddd]
```

2. **SUBSCRIBE request (P-CSCF to I-CSCF) – see example in table 16.5-2**

P-CSCF looks up the serving network information for the public user identity that was stored during the registration procedure. The SUBSCRIBE request is forwarded to I-CSCF. A Route header is inserted into SUBSCRIBE request. The information for the Route header is taken from the path header as gathered during registration.

Table 16.5-2 SUBSCRIBE request (P-CSCF to I-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 69
Route: <sip:icscf1_p.home1.net;lr<,
   <sip:token(sip:scscf1.home1.net:1481orig@scscf1.home1.net;lr)@home1.net;tokenized-
   by=home1.net>
Record-Route: <sip:pcscf1.visited1.net;lr>
P-Asserted-Identity: "John Doe" <sip:user1_public1@home1.net>
P-Access-Network-Info:
Privacy:
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Accept:
Contact:
Content-Length:
```

P-Asserted-Identity: P-CSCF inserts the SIP URI in the P-Asserted-Identity header field and it also removes P-Preferred-Identity header field. **Route:** The Route header is populated with the remaining elements from the Path header from Registration.

P-Asserted-Identity: The P-CSCF inserts this header based on the user's hint present in the incoming P-Asserted-Identity header.

3. **SUBSCRIBE (I-CSCF to S-CSCF) – see example in table 16.5-3**

I-CSCF determines the S-CSCF name in the Route header field to retrieve the routeing information. I-CSCF then forwards the SUBSCRIBE request to the S-CSCF.

Table 16.5-3 SUBSCRIBE (I-CSCF to S-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 68
Route: <sip:scscf1.home1.net:1481orig@scscf1.home1.net;lr>
Record-Route: <sip:icscf1_p.home1.net;lr>, <sip:pcscf1.visited1.net;lr>
P-Asserted-Identity:
P-Access-Network-Info:
Privacy:
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Accept:
Contact:
Content-Length:
```

Record-Route: The I-CSCF adds itself to the Record-Route header as it wants to stay on the routeing path for network hiding purposes.

Upon receiving the INVITESUBSCRIBE, the S-CSCF stores the following information about this session, for use in possible error recovery actions - see example in table 16.5-3b.

Table 16.5-3b: Storage of information at S-CSCF

```
Request-URI: sip:user1_public1@home1.net
From: sip:user1_public1@home1.net;tag=31415
To: sip:user1_public@home1.net
Call-ID: b89rjhnedlrfjflslj40a222
Cseq(2dest): 61 SUBSCRIBE
Cseq(2orig): none
Route(2orig): <sip:icscf1_p.home1.net;lr>, <sip:pcscf1.visited1.net;lr>
Contact(orig):
    <sip:[5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=7200
```

4. **202 (Accepted)200 (OK) response (S-CSCF to I-CSCF) – see example in table 16.5-4**

The S-CSCF first authorizes the subscription. As S-CSCF can trust the content of the P-Asserted-Identity header and <sip:user1_public1@home1.net> is on the list of the authorized users for the 'reg' event package stored by the S-CSCF, therefore the S-CSCF The S-CSCF sends an acknowledgement towards the UE indicating that the subscription was successful. This response will traverse the path that the SUBSCRIBE request took as described in the Via list.

NOTE 1: If the S-CSCF can process the SUBSCRIBE request and send the NOTIFY request immediately, it can send a 200 (OK) response instead of a 202 (Accepted) response.

Table 16.5-4 202 (Accepted)200 (OK) response (S-CSCF to I-CSCF)

```
SIP/2.0 202 Accepted200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Record-Route: <sip:icscf1_p.home1.net;lr>, <sip:pcscf1.visited1.net;lr>
P-Asserted-Identity: <sip:scscf1.home1.net>
Privacy: none
From:
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq:
Contact: <sip:scscf1.home1.net>
Event:
Expires:
Content-Length: 0
```

Expires: If value of the Expires header in SUBSCRIBE request is different from the one received in REGISTER method, then the value of Expires header in ~~202 (Accepted)~~200 (OK) response is set to match the value of Expires header in REGISTER method.

~~**Contact:** This is populated with a identifier generated within the S-CSCF that will help it correlate refreshes for the SUBSCRIBE request. It is assumed to be the public user identity 'user1_public1' in this case.~~

5. ~~**202 (Accepted)**~~**200 (OK) response (I-CSCF to P-CSCF) – see example in table 16.5-5**

The I-CSCF forwards the ~~202 (Accepted)~~200 (OK) response to the P-CSCF.

Table 16.5-5 ~~202 (Accepted)~~200 (OK) response (I-CSCF to P-CSCF)

```
SIP/2.0 ~~202 Accepted~~200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   ~~[5555::aaa:bbb:ccc:ddd]~~[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Record-Route: <sip:icscf1_p.home1.net;lr>, <sip:pcscf1.visited1.net;lr>
P-Asserted-Identity:
Privacy:
From:
To:
Call-ID:
CSeq:
Event:
Contact: <sip:token(sip:scscf1.home1.net)@home1.net;tokenized-by=home1.net>
Expires:
Content-Length:
```

6. ~~**202 (Accepted)**~~**200 (OK) response (P-CSCF to UE) – see example in table 16.5-6**

The P-CSCF sends the ~~202 (Accepted)~~200 (OK) response to the UE.

Table 16.5-6 ~~202 (Accepted)~~200 (OK) response (P-CSCF to UE)

```
SIP/2.0 ~~202 Accepted~~200 OK
Via: SIP/2.0/UDP
   ~~[5555::aaa:bbb:ccc:ddd]~~[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Record-Route: <sip:icscf1_p.home1.net;lr>, <sip:pcscf1.visited1.net:7531;lr;comp=sigcomp>
P-Asserted-Identity:
Privacy:
From:
To:
Call-ID:
CSeq:
Event:
Contact
Expires:
Content-Length:
```

7. **NOTIFY request (S-CSCF to I-CSCF) – see example in table 16.5-7**

The S-CSCF sends a first NOTIFY request towards the UE in order to inform the UE about the registration status of the monitored user.

In the example below, the NOTIFY request specifies the following public user identities as registered (i.e. status=open): sip:user1_public1@home1.net, tel: +498972233114;

The following public user identity has been deregistered (i.e. status=closed) sip:user1_public2@home1.net. They are arranged in the preferred order of priority in this example.

~~The Route header is constructed from the information saved at registration.~~

Table 16.5-7 NOTIFY request (S-CSCF to I-CSCF)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
Route: <sip:icscf1_p.home1.net;lr>, <sip:pcscf1.visited1.net;lr>
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@home1.net>;tag=31415
Call-ID:
CSeq: 42 NOTIFY
Contact: <sip:scscf1.home1.net>
Subscription-State: active;expires=7200
Event: reg
Content-Type: application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:">

        <tuple name="sip:user1_public1@home1.net">
          <status><basic>open</basic></status>
        </tuple>

        <tuple name="sip:user1_public2@home1.net">
          <status><basic>closed</basic></status>
        </tuple>

        <tuple name="tel:+498972233114">
          <status><basic>open</basic></status>
        </tuple>

      </presence>
```

From: The tag of this field matches that of the To; field in the received 200~~/202~~ (OK) response for the SUBSCRIBE request.

Content-Type: Set to the value of the Accept header received in the SUBSCRIBE request or 'application/cpim-pidf+xml' if the Accept header was not present in the SUBSCRIBE request.

The message body in the NOTIFY request that carries the subscriber's registration state is described as indicated in 3GPP TS 24.229 [16].

8. **NOTIFY request (I-CSCF to P-CSCF) – see example in table 16.5-8**

   The I-CSCF translates the S-CSCF address in the Via header and forwards the NOTIFY request to the P-CSCF.

Table 16.5-8 NOTIFY request (I-CSCF to P-CSCF)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1)@home1.net;tokenized-by=home1.net
Max-Forwards: 69
Route: sip:pcscf1.visited1.net;lr
From:
To:
Call-ID:
Cseq:
Contact: <sip:token(sip:scscf1.home1.net)@home1.net;tokenized-by=home1.net>
Subscription-State:
Event:
Content-Type:
Content-Length:
```

9. **NOTIFY request (P-CSCF to UE) – see example in table 16.5-9**

   The P-CSCF sends the NOTIFY request to the UE.

Table 16.5-9 NOTIFY request (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1)@home1.net;tokenized-by=home1.net
Max-Forwards: 68
From:
To:
Call-ID:
CSeq:
Contact:
Subscription-State:
Event:
Content-Type:
Content-Length:
```

10. **200 (OK) response (UE to P-CSCF) – see example in table 16.5-10**

UE responds with 200 (OK) response to the NOTIFY request.

Table 16.5-10 200 (OK) response (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1)@home1.net;tokenized-by=home1.net
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

11. **200 (OK) response (P-CSCF to I-CSCF) – see example in table 16.5-11**

P-CSCF forwards the 200 (OK) response to the I-CSCF.

Table 16.5-11 200 (OK) response (P-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1)@home1.net;tokenized-by=home1.net
P-Access-Network-Info:
From:
To:
Call-ID:
CSeq:
Content-Length:
```

12. **200 (OK) response (I-CSCF to S-CSCF) – see example in table 16.5-12**

I-CSCF determines the request and forwards response to S-CSCF. This confirms that notification is reached to the user.

Table 16.5-12 200 (OK) response (I-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
P-Access-Network-Info:
From:
To:
Call-ID:
CSeq:
Content-Length:
```

16.6 P-CSCF subscription for the registration state event package

This subclause describes the subscription procedure for the registration state event package, whereby the P-CSCF requests to be notified by the S-CSCF when the event has occurred. This is done using the 'reg' package.

It is assumed that the user has registered prior to initiating subscription of an event. Also, the subscriber is considered to be roaming and the home network has network configuration hiding active. For this example the trigger point at the P-CSCF for sending out the SUBSCRIBE request is the 200 (OK) response of the user's registration.

~~Editor's Note: The interaction between the explicit subscription procedure for the `Event: reg event package` and the registration procedures needs further consideration. For example: What are the appropriate timer values of Expires header for these procedures considering the signalling is over the radio interface? What is the status of the ongoing explicit subscription procedure (`Event: reg event package`) when the registration timer has expired? etc.~~

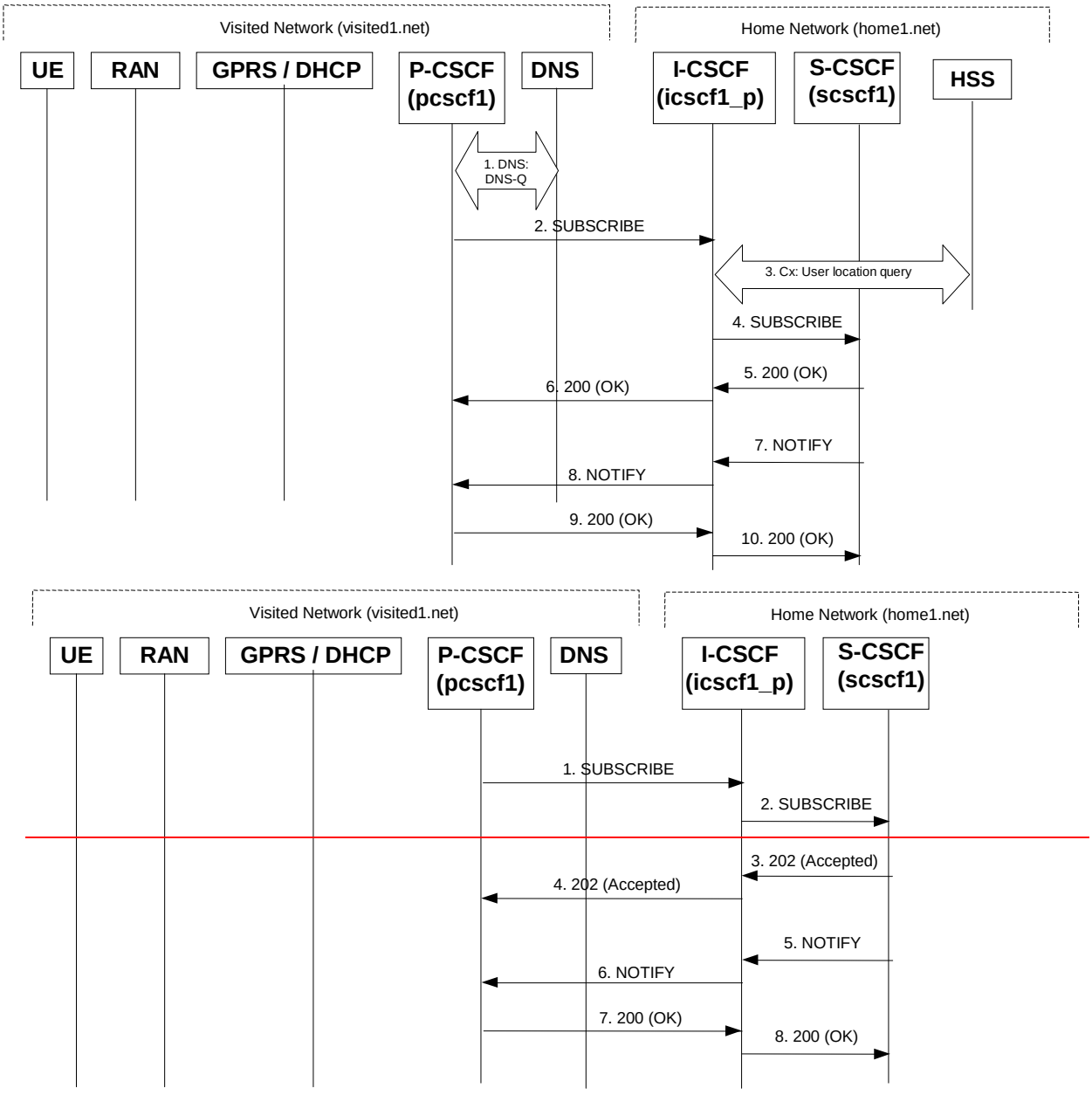

Figure 16.6-1: P-CSCF subscription for the registration state event package (with I-CSCF providing configuration independence)

1. **DNS: DNS-Q**

The P-CSCF performs the DNS queries to locate the I-CSCF in the home network. The look up in the DNS is based on the address specified in the Request URI.

~~1~~2. **SUBSCRIBE request (P-CSCF to I~~S~~-CSCF) – see example in table 16.6-2~~1~~**

The P-CSCF generates a SUBSCRIBE request in order to subscribe for the reg event package.

~~The route is constructed from the monitored users path header as constructed during registration.~~

Table 16.6-2~~1~~ SUBSCRIBE request (P-CSCF to I-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1
Max-Forwards: 70
Route: <sip:icscf1_p.home1.net;lr>, <sip:token(sip:scscf1.home1.net;lr)@home1.net;tokenized-
   by=home1.net>
P-Asserted-Identity: <sip:pcscf1.visited1.net>
Privacy: none
From: <sip:pcscf1.visited1.net>;tag=31415
To: <sip:user1_public1@home1.net>
Call-ID: dre36d2v32gnlgiiomm72445
CSeq: 61 SUBSCRIBE
Event: reg
Expires: 7200
Accept: application/cpim-pidf+xml
Contact: <sip:_user1_public1%40home1.net@pcscf1.visited1.net>
Content-Length: 0
```

Request URI: Identifies the resource to subscribe.

Max-Forwards: Set to 70 by the P-CSCF and used to prevent loops.

Route: The token containing a representation of the I-CSCF and S-CSCF allocated to this user, based on the registration Service-Route information.

From: This header is populated with the SIP URI that identifies the P-CSCF.

To: The SIP-URI of the resource to which the subscription is sent..

Contact: This is where the NOTIFY requests for this subscription will be sent. It consists of the SIP URL escaped public user identity at the P-CSCF.

Event: This field is set to the value 'reg' to specify the use of the reg event package

Accept: This field is set to the value 'application/cpim-pidf+xml'.

3. **Cx: User Location Query procedure**

The I-CSCF sends a query to the HSS to find out the S-CSCF of the called user. The HSS responds with the address of the current S-CSCF for the terminating subscriber.

For detailed message flows see 3GPP TS 29.228 [11].

Table 16.6-3a provides the parameters in the SIP SUBSCRIBE request (flow 2), which are sent to the HSS.

Table 16.6-3a Cx: User registration status query procedure (I-CSCF to HSS)

Message source & destination	Cx: Information element name	Information source in SIP INVITE	Description
I-CSCF to HSS	User Public Identity	Request-URI:	This information element indicates the public user identity

Table 16.6-3b provides the parameters sent from the HSS that need to be mapped to SIP SUBSCRIBE (flow 4) and sent to S-CSCF.

Table 16.6-3b Cx: User registration status query procedure (HSS to I-CSCF)

Message source & destination	Cx: Information element name	Mapping to SIP header in SIP INVITE	Description
HSS to I-CSCF	S-CSCF name	Route header field	This information indicates the serving CSCF's name of that user

~~2~~4. **SUBSCRIBE request (I-CSCF to S-CSCF) – see example in table 16.6-~~4~~42**

~~I-CSCF determines the S-CSCF name in the Route header field to retrieve the routeing information.~~ The I-CSCF ~~then~~ forwards the SUBSCRIBE request to S-CSCF.

Table 16.6-~~4~~42 SUBSCRIBE request (I-CSCF to S-CSCF)

```
SUBSCRIBE sip:user1_public1@home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1
Max-Forwards: 69
Record-Route: <sip:icscf1_p.home1.net;lr>
Route: <sip:scscf1.home1.net;lr>
P-Asserted-Identity:
Privacy:
From:
To:
Call-ID:
CSeq:
Event:
Expires:
Accept:
Contact:
Content-Length:
```

Record-Route: The I-CSCF adds itself to the Record-Route header as it wants to stay on the routeing path for network hiding purposes.

~~5~~3. ~~202 (Accepted)~~200 (OK) **response (S-CSCF to I-CSCF) – see example in table 16.6-~~5~~3**

The S-CSCF first authorizes the subscription. As S-CSCF can trust the content of the P-Asserted-Identity header and <sip:pcscf1.visited1.net> is on the list of the authorized users for the 'reg' event package stored by the S-CSCF, therefore the S-CSCF ~~The S-CSCF~~ sends an acknowledgement towards the P-CSCF indicating that the subscription was successful. ~~This response will traverse the path that the SUBSCRIBE request took as described in the Via list.~~

~~NOTE 1: If the S-CSCF can process the SUBSCRIBE request and send the NOTIFY request immediately, it can send a 200 (OK) response instead of a 202 (Accepted) response.~~

Table 16.6-~~5~~3 ~~202 (Accepted)~~200 (OK) response (S-CSCF to I-CSCF)

```
SIP/2.0 202 Accepted200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1
P-Asserted-Identity: <sip:scscf1.home1.net>
Privacy:
Record-Route: <sip:icscf1_p.home1.net;lr>
From:
To: <sip:user1_public1@home1.net>;tag=151170
Call-ID:
CSeq:
Contact: <sip:scscf1.home1.net>
Event:
Expires:
Content-Length: 0
```

~~6~~4. ~~202 (Accepted)~~200 (OK) **response (I-CSCF to P-CSCF) – see example in table 16.6-~~6~~4**

The I-CSCF forwards ~~202 (Accepted)~~200 (OK) response to the P-CSCF.

Table 16.6-~~6~~4 ~~202 (Accepted)~~200 (OK) response (I-CSCF to P-CSCF)

```
SIP/2.0 ~~202 Accepted~~200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1
Record-Route: <sip:icscf1_p.home1.net;lr>
P-Asserted-Identity: <sip:token(sip:scscf1.home1.net)@home1.net;tokenized-by=home1.net>
Privacy:
From:
To:
Call-ID:
CSeq:
Contact: <sip:token(sip:scscf1.home1.net)@home1.net;tokenized-by=home1.net>
Event:
Expires:
Content-Length:
```

7~~5~~. **NOTIFY request (S-CSCF to I-CSCF) – see example in table 16.6-7~~5~~**

The S-CSCF sends a first NOTIFY request towards the P-CSCF in order to inform the P-CSCF about the registration status of the monitored user.

The Route header is constructed from the Record-Route header as constructed during subscription.

Table 16.6-7~~5~~ NOTIFY request (S-CSCF to I-CSCF)

```
NOTIFY sip:~~user1_public1%40home1.net@~~pcscf1.visited1.net SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
Route: <sip:icscf1_p.home1.net;lr>
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:pcscf1.visited1.net>;tag=31415
Call-ID:
CSeq: 42 NOTIFY
Contact: <sip:scscf1.home1.net>
Subscription-State: active;expires=7200
Event: reg
Content-Type: application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:">

        <tuple name="sip:user1_public1@home1.net">
          <status><basic>closed</basic></status>
        </tuple>

</presence>
```

~~**Request-URI:** The contents are the same as the Contact header in the SUBSCRIBE request.~~

From: The tag of this field matches that of the To; field in the received 200 (OK)~~/202~~ response for the SUBSCRIBE request.

Content-Type: Set to the value of the Accept header received in the SUBSCRIBE request or 'application/cpim-pidf+xml' if the Accept header was not present in the SUBSCRIBE request.

The message body in the NOTIFY request that carries the subscriber's registration state is described as indicated in 3GPP TS 24.229 [16].

8~~6~~. **NOTIFY request (I-CSCF to P-CSCF) – see example in table 16.6-8~~6~~**

The I-CSCF translates the S-CSCF address in the Via header and forwards the NOTIFY request to the P-CSCF.

Table 16.6-~~8~~6 NOTIFY request (I-CSCF to P-CSCF)

```
NOTIFY sip:user1_public1%40home1.net@pcscf1.visitedhome1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1)@home1.net;tokenized-by=home1.net
Max-Forwards: 69
From:
To:
Call-ID:
Cseq:
Contact: <sip:token(sip:scscf1.home1.net)@home1.net;tokenized-by=home1.net>
Subscription-State:
Event:
Content-Type:
Content-Length:
```

~~7~~9. **200 (OK) response (P-CSCF to I-CSCF) – see example in table 16.6-9~~7~~**

P-CSCF forwards the 200 (OK) response to the I-CSCF.

Table 16.6-9~~7~~ 200 (OK) response (P-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1)@home1.net;tokenized-by=home1.net
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

~~8~~10. **200 (OK) response (I-CSCF to S-CSCF) – see example in table 16.6-10~~8~~**

I-CSCF determines the request and forwards response to S-CSCF. This confirms that notification is reached to the user.

Table 16.6-~~8~~10 200 (OK) response (I-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
From:
To:
Call-ID:
CSeq:
Content-Length:
```

16.7 Notifying of the network initiated deregistration event (not provided)

16.8 Network initiated re-authentication

This subclause describes the notification that occurs when the S-CSCF assigned to that user requests re-authentication in the case where the user's home network provides network configuration hiding.

It is assumed that user has registered and also subscribed to the registration state event before. Also, the subscriber is considered to be roaming and the home network operator does not desire to keep its internal configuration hidden from the visited network.

After this procedure the user's UE might automatically initiate re-registration procedures. If the user fails to re-register the public user identity for which re-authentication was requested, the public user identity may be deregistered by S-CSCF.

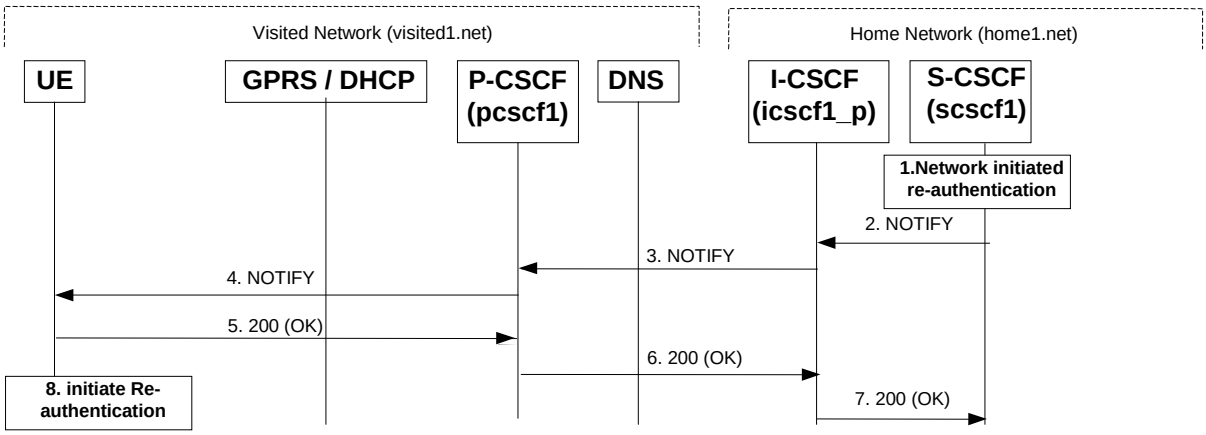

Figure 16.8-1: S-CSCF informs UE that network initiated re-authentication is needed (with I-CSCF providing configuration independence)

1. **Network initiated re-authentication (S-CSCF)**

   The network-initiated re-authentication event for the private user identity user occurs at the S-CSCF. As the user has subscribed to the registration state event package this is the trigger point for the S-CSCF to notify the user about the event occurrence. For simplicity, the NOTIFY request towards the P-CSCF is not shown.

2. **SIP NOTIFY request (S-CSCF to I-CSCF) – see example in table 16.8-2**

   The S-CSCF sends a NOTIFY request towards the UE in order to inform the UE about the occurrence of the network initiated re-authentication event.

   ~~The Route header is constructed from the information saved at registration.~~

Table 16.8-2 SIP NOTIFY request (S-CSCF to I-CSCF)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
Max-Forwards: 70
Route: <sip:icscf1_p.home1.net;lr>, <sip:pcscf1.visited1.net;lr>
From: <sip:user1_public1@home1.net>;tag=151170
To: <sip:user1_public1@home1.net>;tag=31415
Call-ID: b89rjhnedlrfjflslj40a222
CSeq: 43 NOTIFY
Subscription-State: active;expires=37200
Event: reg
Contact: sip:scscf1.home1.net
Content-Type: application/cpim-pidf+xml
Content-Length: (...)

<presence xmlns="urn:ietf:params:xml:ns:cpim-pidf:"
     xmlns:registration="urn:ietf:params:xml:ns:cpim-pidf:registration">

        <tuple name="sip:user1_public1@home1.net">
          <status>
     <basic>open</basic>
     <registration>re-authenticate</registration>
     </status>
        </tuple>
      </presence>
```

From: The tag of this field matches that of the To; field in the received 200/202 response for the SUBSCRIBE request.

Content-Type: Set to the value of the Accept header received in the SUBSCRIBE request or 'application/cpim-pidf+xml' if the Accept header was not present in the SUBSCRIBE request.

The message body in the NOTIFY request that carries the subscriber's registration state is described as indicated in 3GPP TS 24.229 [16].

3. **SIP NOTIFY request (I-CSCF to P-CSCF) – see example in table 16.8-3**

   The I-CSCF translates the S-CSCF address in the Via header and forwards the NOTIFY request to the P-CSCF.

Table 16.8-3 SIP NOTIFY request (I-CSCF to P-CSCF)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1)@home1.net;tokenized-by=home1.net
Max-Forwards: 69
Route: <sip:pcscf1.visited1.net;lr>
From:
To:
Call-ID:
Cseq:
Subscription-State:
Event:
Contact: <sip:token(sip:scscf1.home1.net)@home1.net;tokenized-by=home1.net>
Content-Type:
Content-Length:
```

4. **SIP NOTIFY request (P-CSCF to UE) – see example in table 16.8-4**

   The P-CSCF sends the NOTIFY request to the UE.

Table 16.8-4 SIP NOTIFY request (P-CSCF to UE)

```
NOTIFY sip:[5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp SIP/2.0
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1)@home1.net;tokenized-by=home1.net
Max-Forwards: 68
From:
To:
Call-ID:
CSeq:
Subscription-State:
Event:
Contact:
Content-Type:
Content-Length:
```

5. **SIP 200 (OK) response (UE to P-CSCF) – see example in table 16.8-5**

   UE responds with a 200 (OK) response to the NOTIFY request.

Table 16.8-5 SIP 200 (OK) response (UE to P-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP pcscf1.visited1.net:7531;comp=sigcomp;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP token(SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1)@home1.net;tokenized-by=home1.net
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From:
To:
Call-ID:
CSeq:
Content-Length: 0
```

6. **SIP 200 (OK) response (P-CSCF to I-CSCF) – see example in table 16.8-6**

   P-CSCF forwards the 200 (OK) response to the I-CSCF.

Table 16.8-6 SIP 200 (OK) response (P-CSCF to I-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP Token(SIP/2.0/UDP
   scscf1.home1.net;branch=z9hG4bK332b23.1)@home1.net;tokenized-by=home1.net
P-Access-Network-Info:
From:
To:
Call-ID:
CSeq:
Content-Length:
```

7. **SIP 200 (OK) response (I-CSCF to S-CSCF) – see example in table 16.8-7**

   I-CSCF determines the request and forwards response to S-CSCF. This confirms that notification has reached the UE.

Table 16.8-7 SIP 200 (OK) response (I-CSCF to S-CSCF)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP scscf1.home1.net;branch=z9hG4bK332b23.1
P-Access-Network-Info:
From:
To:
Call-ID:
CSeq:
Content-Length:
```

8. **Re-authentication (UE)**

   The UE now initiates the re-authentication procedures.

16.9 Registration error conditions

16.9.1 Reregistration – failure of reregistration

This signalling flow (see figure 16.9.1-1) is a continuation of the signalling flow in subclause 16.3 after reception of signalling flow 4. This signalling flow shows the recovery after a failure of the S-CSCF that had been assigned to the subscriber in a previous registration.

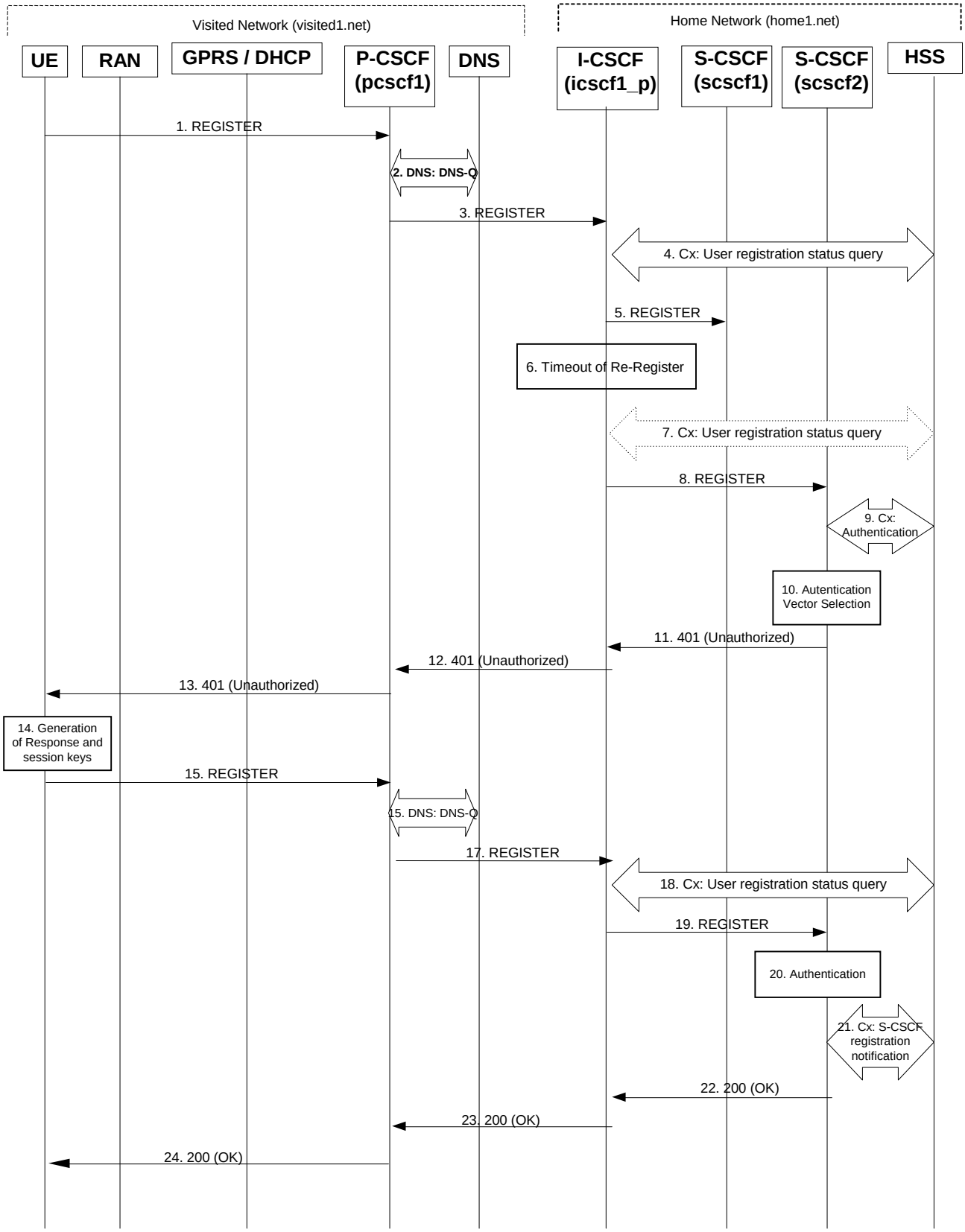

Figure 16.9.1-1: Failure of previous S-CSCF during reregistration

Steps 1 through 4 are the same as the signalling flow in subclause 16.3.

5 **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.9.1-5**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected. The Request-URI is changed to the address of the S-CSCF.

I-CSCF adds a proper I-CSCF name to the Path header.

Table 16.9.1-5 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf1.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
P-Access-Network-Info:
Max-Forwards: 68
Path: <sip:icscf1_p.home1.net;lr>, <sip:term@pcscf1.visited1.net;lr>
Require: path
P-Visited-Network-ID: "Visited Network Number 1"
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>>;expires=7200
Call-ID: apb03a0s09dkjdfglkj49111
Authorization: Digest username="user1_private@home1.net", realm="registrar.home1.net",
   nonce=base64(RAND + AUTN + server specific data), algorithm=AKAv1-MD5,
   uri="sip:registar.home1.net", response="0a1b04c89e54f09ab45e84d30e29f83a", integrity-
   protected="yes"
CSeq: 10 REGISTER
Supported: path
Expires: 7200
Content-Length: 0
```

6 **Timeout of reregister**

The I-CSCF times out, waiting for the response from the S-CSCF.

Editor's Note: The value of the timer in this particular instance is FFS. Clearly the value of the timers in the P-CSCF and UE waiting for the response must be considered when choosing this value.

7 **Cx: User registration status query (Optional)**

The I-CSCF informs the HSS that the S-CSCF for the subscriber is unreachable and requests information related to the required S-CSCF capabilities from the HSS, The HSS sends the capability information required for S-CSCF selection. The I-CSCF uses this information to select a suitable S-CSCF.

This step is optional. Depending on implementation, sufficient information may be available to the I-CSCF from Step 4, to allow the I-CSCF select an alternate S-CSCF. Alternative mechanisms (for example a CSCF management plane) would be used to enable the HSS learn of S-CSCF failure. In addition, the HSS will learn about the assignment of a new S-CSCF in Step 9.

8 **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.9.1-8**

This signalling flow forwards the REGISTER request from the I-CSCF to the newly selected S-CSCF. The Request-URI is changed to the address of the new S-CSCF.

Table 16.9.1-8 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf2.home1.net SIP/2.0
Via:
P-Access-Network-Info:
Max-Forwards: 687
Path:
Require:
P-Visited-Network-ID:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Supported:
Expires:
Content-Length:
```

The next ten steps (9 to 18) are the same as in the normal reregistration case (steps 6 to 12 in subclause 16.3).

19. **REGISTER request (I-CSCF to S-CSCF) – see example in table 16.9.1-19**

This signalling flow forwards the REGISTER request from the I-CSCF to the S-CSCF selected.

Table 16.9.1-19 REGISTER request (I-CSCF to S-CSCF)

```
REGISTER sip:scscf2.home1.net SIP/2.0
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
   pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
   [5555::aaa:bbb:ccc:ddd][5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 68
P-Access-Network-Info:
Path: <sip:icscf1_p.home1.net;lr>, <sip:term@pcscf1.visited1.net;lr>
Require:
P-Visited-Network-ID:
From:
To:
Contact:
Call-ID:
Authorization:
CSeq:
Supported:
Expires:
Content-Length:
```

Path: The S-CSCF stores the contents of the Path header and uses these URIs for routeing mobile terminated sessions.

The remaining steps (20-25) are the same as in the normal reregistration case (steps 17-22 in subclause 16.3)