IMS Presentation 2

with Focus on Registration Procedure

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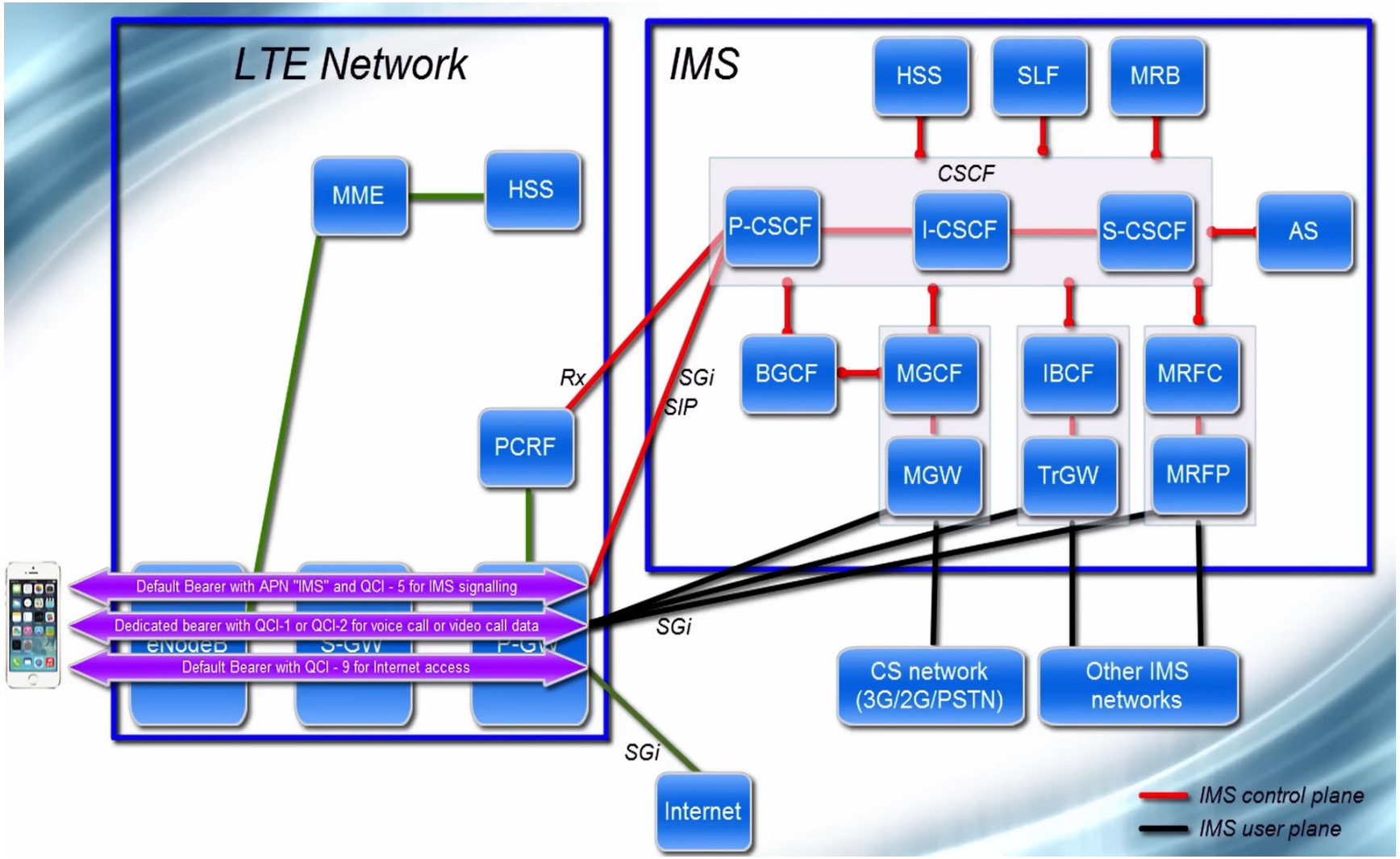
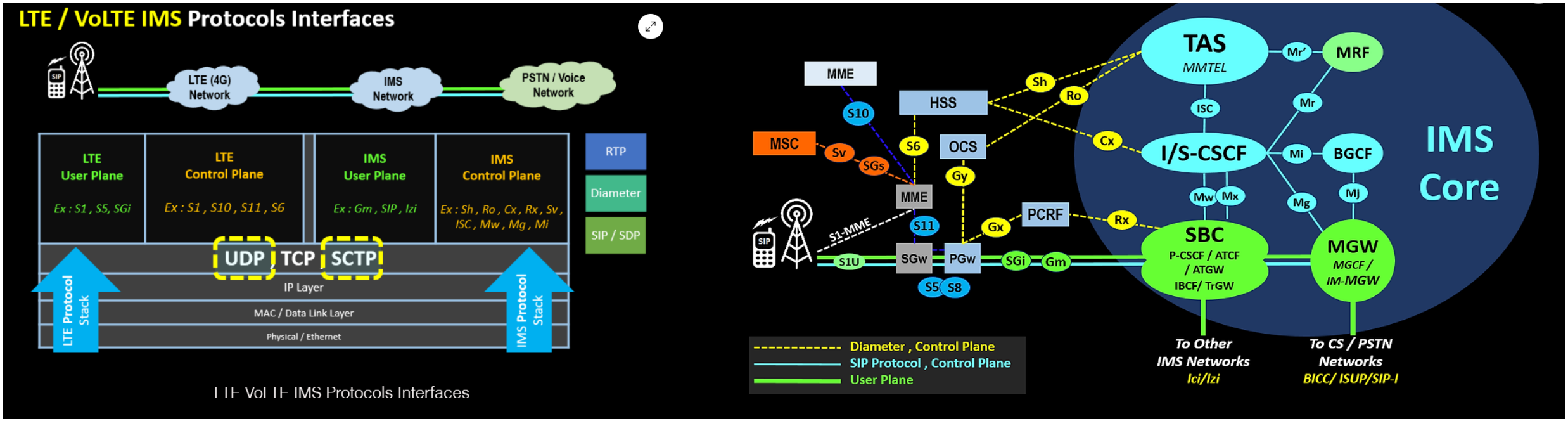
IMS Architecture



IMS Protocols and Interfaces



SCTP connection oriented
Used for Close reliable networks(e.g. Charging and Auth.)

UDP connectionless
Used for long distance and open networks(e.g. Roaming)

UICC-USIM,ISIM

- **UICC : Universal Integrated Circuit Card**
  - is the physical card and 2G SIM/USIM/ISIM are applications on the UICC card.
  - ISIM and USIM are **applications** which run in your UICC
- **USIM: Universal Subscriber Identity Module**
  - IMSI,
  - SPN,
  - Cyphering and Authentication keys used during registration in UMTS/LTE networks.
  - is used during NAS/RRC/MM/GMM procedures.
- **ISIM: IP Multimedia Services Identity Module**
  - IP Multimedia Private Identity (IMPI),
  - domain,
  - IP Multimedia Public Identity (IMPU) and
  - cypher keys (used to encryp information. So, this application is used for SIP/IMS procedures - consequently, VoLTE calls).
  - Is used during SIP/IMS procedures

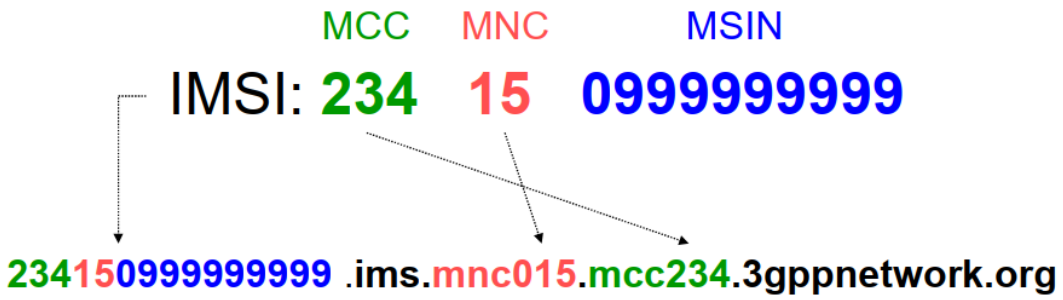
- 3GPP defines standards which make possible to create a IMPI/IMPU using keys from your USIM.
- neither ISIM nor USIM is present, but IMC is present, within IMC .
- when neither ISIM nor USIM nor IMC is present, the private user identity is available to the UE via other means

User Identities

- Private User Identity (IMPI in IMS)
- Public User Identity (IMPU in IMS)

Private User Identities (IMPI in IMS)

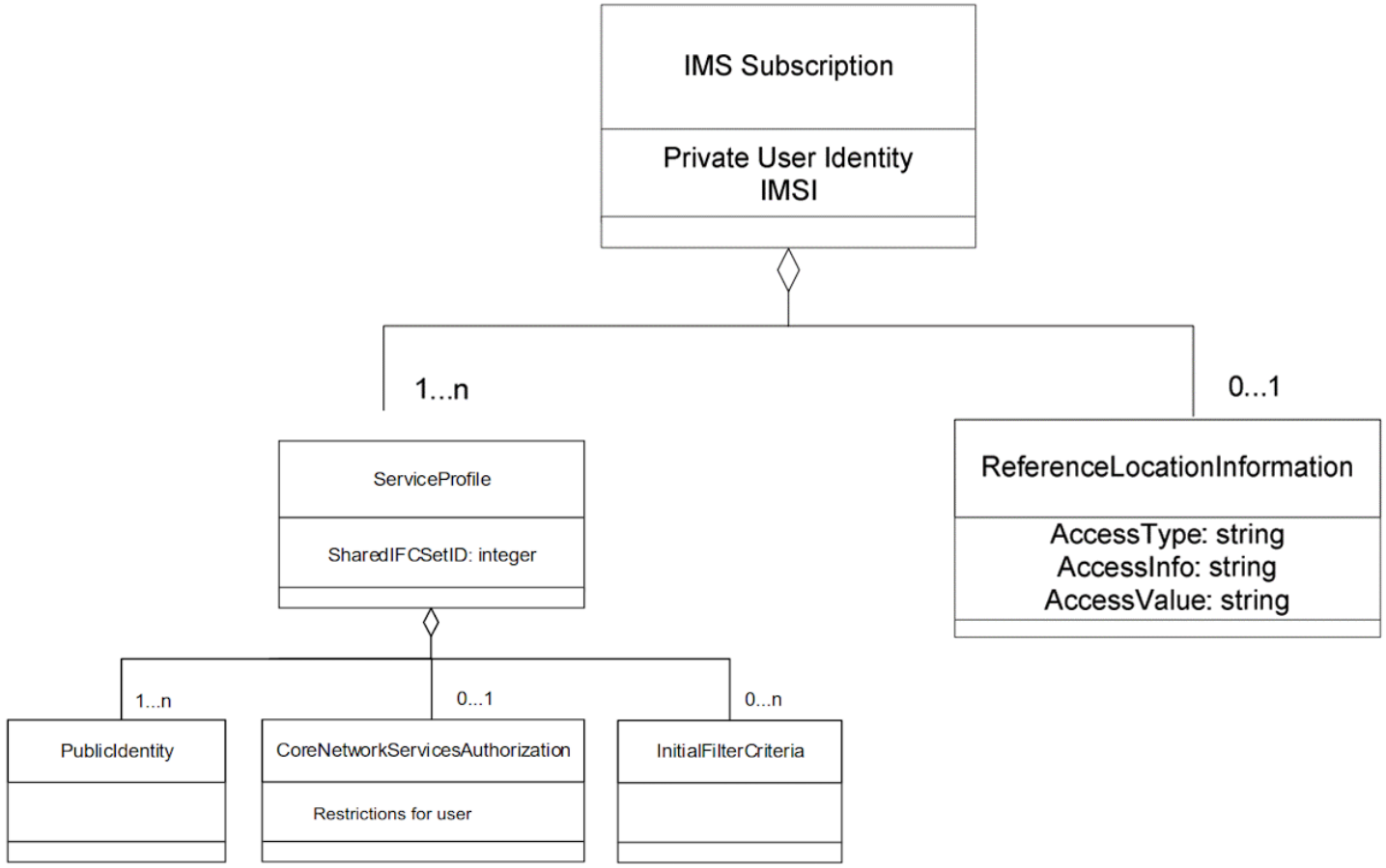
- IMS user shall have one or more Private User Identities. ISIM stores IMPI
- Is not used for routing of SIP messages.
- shall be contained in all Registration requests, (including Re-registration and Deregistration requests in Authorization header) passed from the UE to the home network .
- stored within the HSS, Identifies Subscription.
- permanently allocated to a user's subscription (it is not a dynamic identity)



Public User Identities (IMPU in IMS)

- SIP URI or Tel URI
- including at least one taking the form of a SIP URI used in To, From headers
- The Public User Identity is used by any user for requesting communications to other users.

User Profile



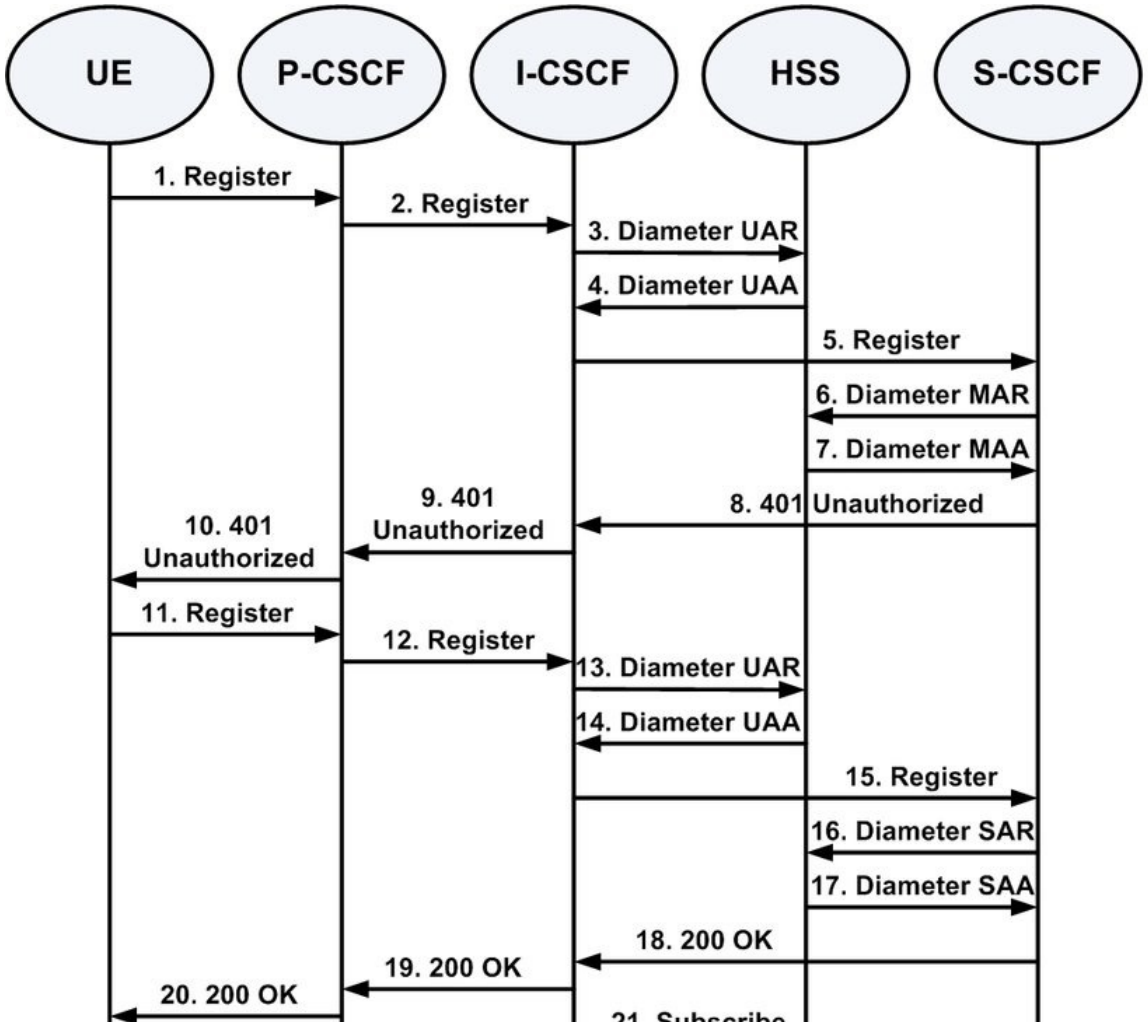
Application Level Registration

- Communicate without REGISTER? Absolutely!
  - point to point
  - To known IP addresses

- IMS Registration
  - Routing through proxy(PCSCF)
  - Authentication of private user identity
  - SIP server(SCSCF) assignment for user handling

Registration Information Flow

User not registered

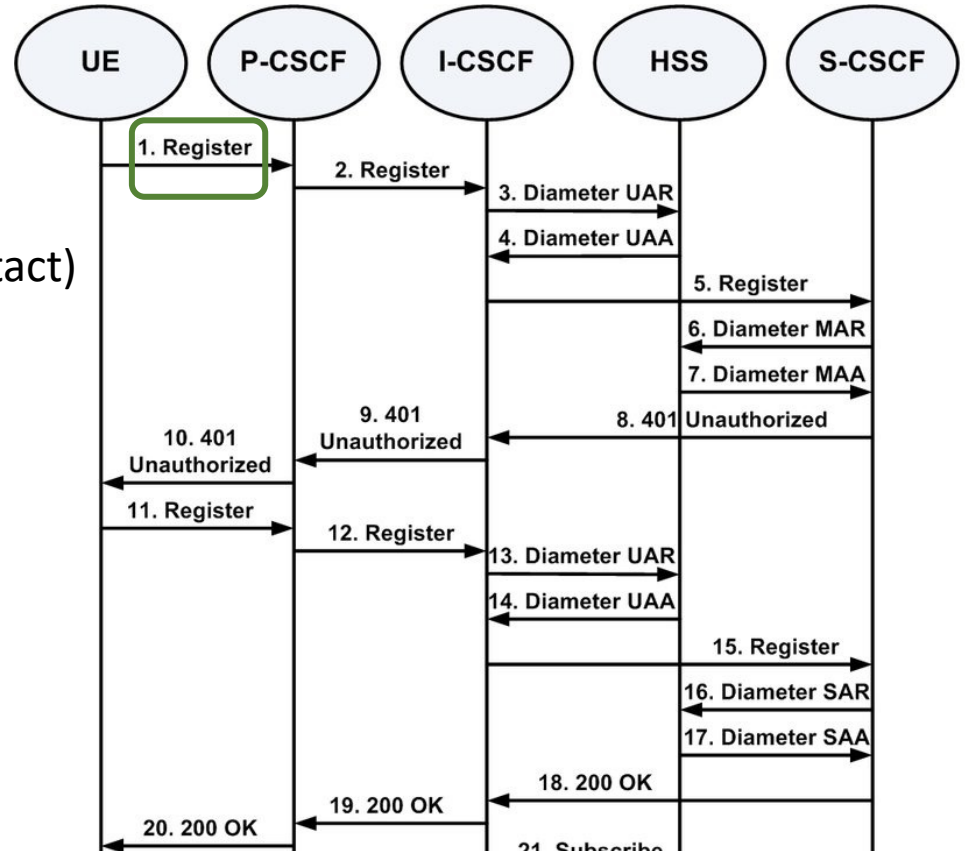


Registration Scenario Assumptions

- Bearer is already established for signaling and a mechanism exists for the first REGISTER message to be forwarded to the proxy
- Actually This registration is Application level Registration !
- After Access Registration
- The user is considered to be always roaming.
- PCSCF Address is known to UE from Proxy-CSCF discovery

REGISTER request (UE to P-CSCF)

Public User Identity(To/From headers)
Private User Identity (Authorization header)
Home Network Domain(Request-line)
UE IP address(achieved in PDP context or bearer establishment->via and contact)



The destination domain of this REGISTER request

```
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=600000
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-c=23456789; spi-s=12345678; port-c=2468; port-
s=1357
Require: sec-agree
Proxy-Require: sec-agree
CSeq: 1 REGISTER
Supported: path
Content-Length: 0
```

DNS Query to Resolve Home Domain

- Based on the address in 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
```

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)

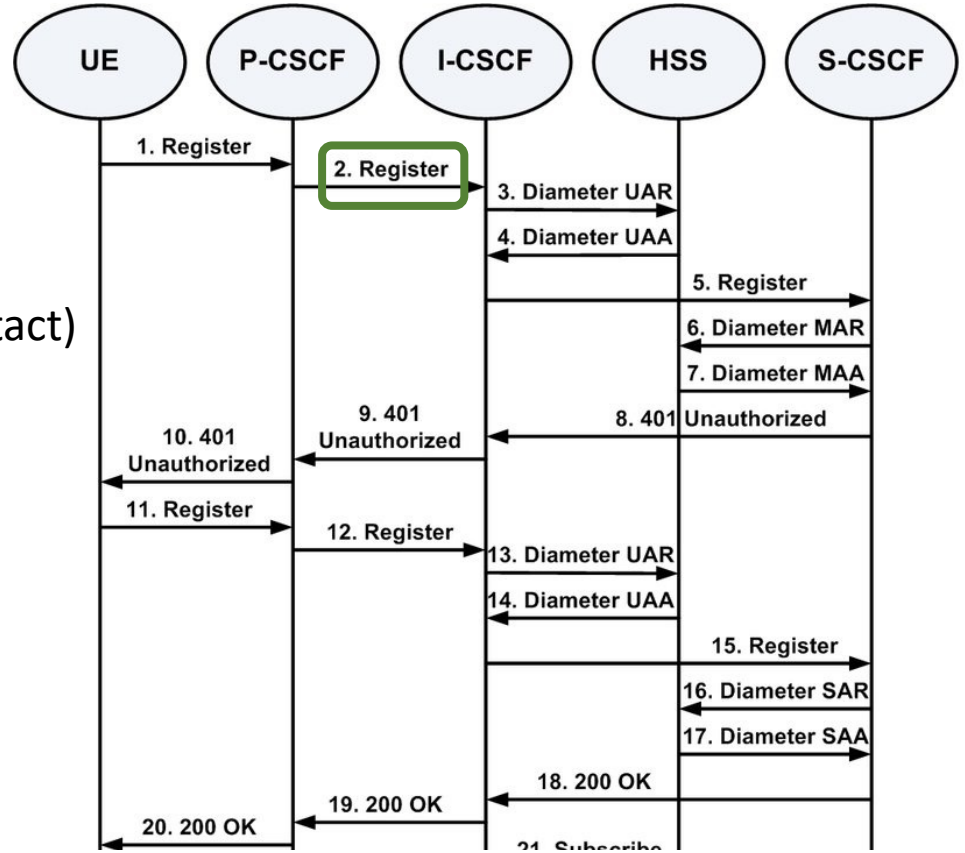
```
OPCODE=SQUERY, RESPONSE, AA
QNAME=_sip._udp.registrar.home1.net, QCLASS=IN, QTYPE=SRV

_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
```

REGISTER request (P-CSCF to I-CSCF)

PCSCF address/name (P-Visited-Network+via+Path)
Public User Identity(To/From headers)
Private User Identity (Authorization header)
Home Network Domain(Request-line)
UE IP address(achieved in PDP context or bearer establishment->via and contact)

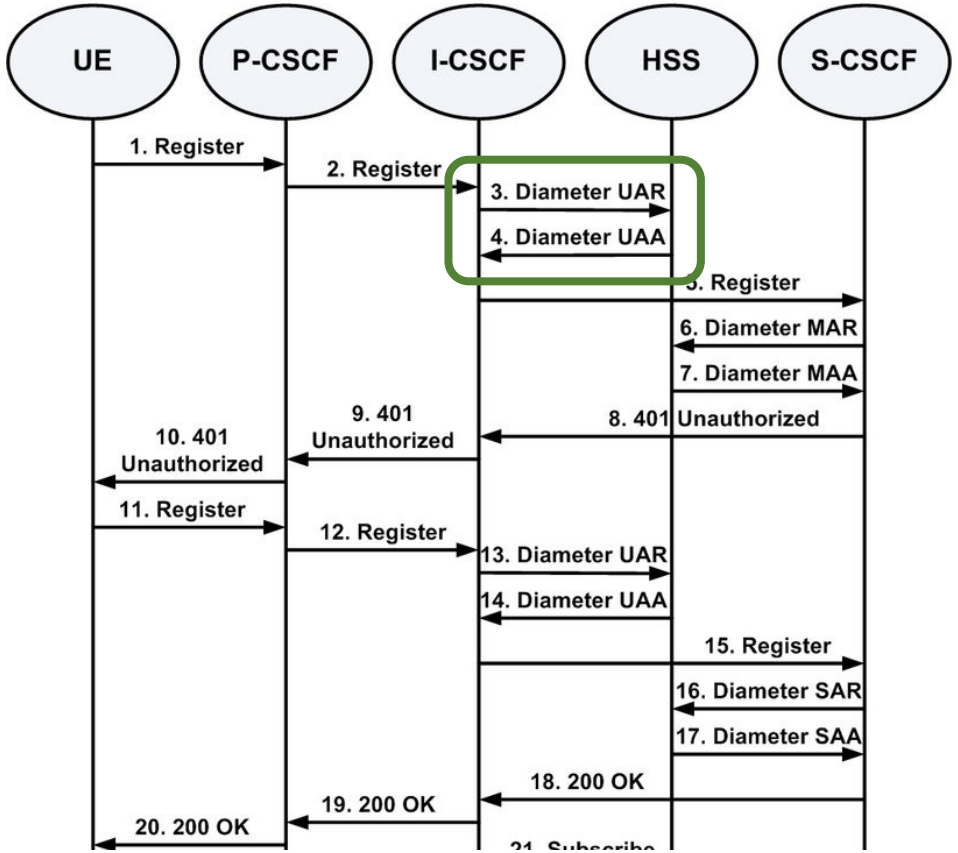
```
REGISTER sip:registrar.home1.net SIP/2.0
   Via: SIP/2.0/UDP pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
        [5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 69
P-Access-Network-Info:
Path: <sip:term@pcscf1.visited1.net;lr>
Require: path
P-Visited-Network-ID: "Visited Network Number 1"
P-Charging-Vector: icid-value="AyretyU0dm+6O2IrT5tAFrbHLso=023551024"
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:
Content-Length:
```

domain name or any other identifier



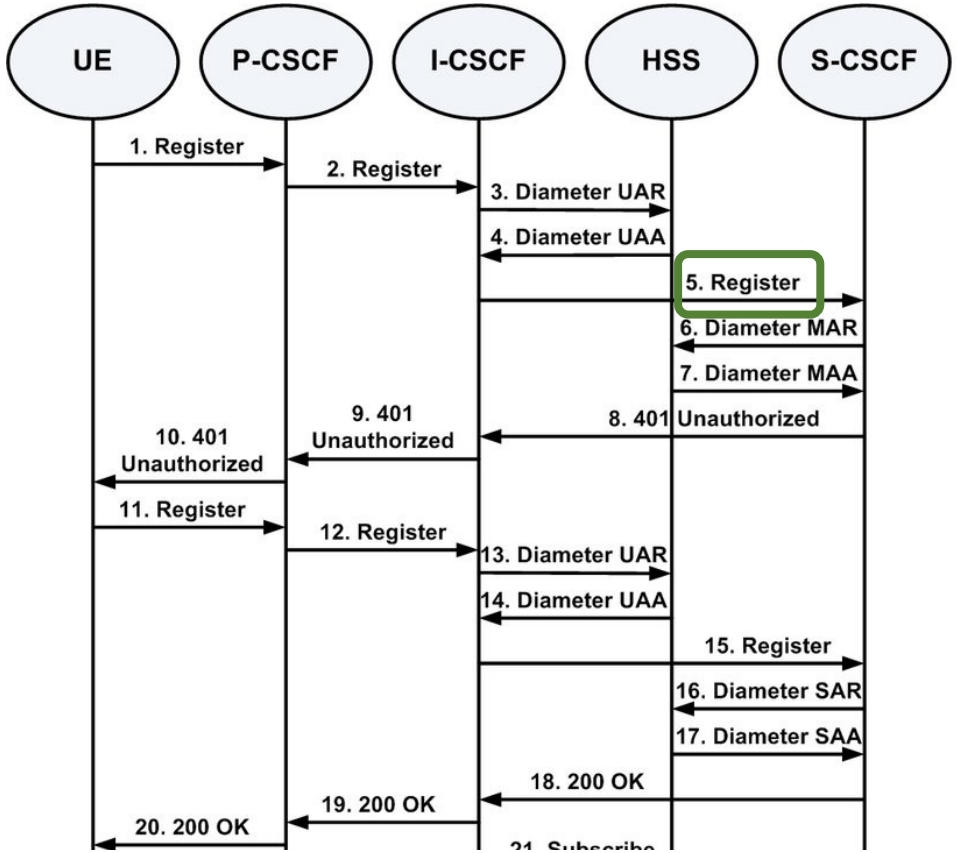
UAR/UAA (I-CSCF <-> HSS)

- UAR : User Authorization Request (IMPI,IMPU,Visited network identifier)
  - Is user allowed?
  - List of capable Servers?
  - visited network is restricted?->rejection
- UAA: User Authorization Answer
  - Address of SIP servers capable of handling this user



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:
Content-Length:
```



S-CSCF name obtained by algorithms with ICSCF:

- Capabilities of individual S-CSCFs in the home network,
- Topological (i.e. P-CSCF) information of where the user is located ,
- Topological information of where the S-CSCF is located,
- Availability of S-CSCFs This is internal information within the operator's network

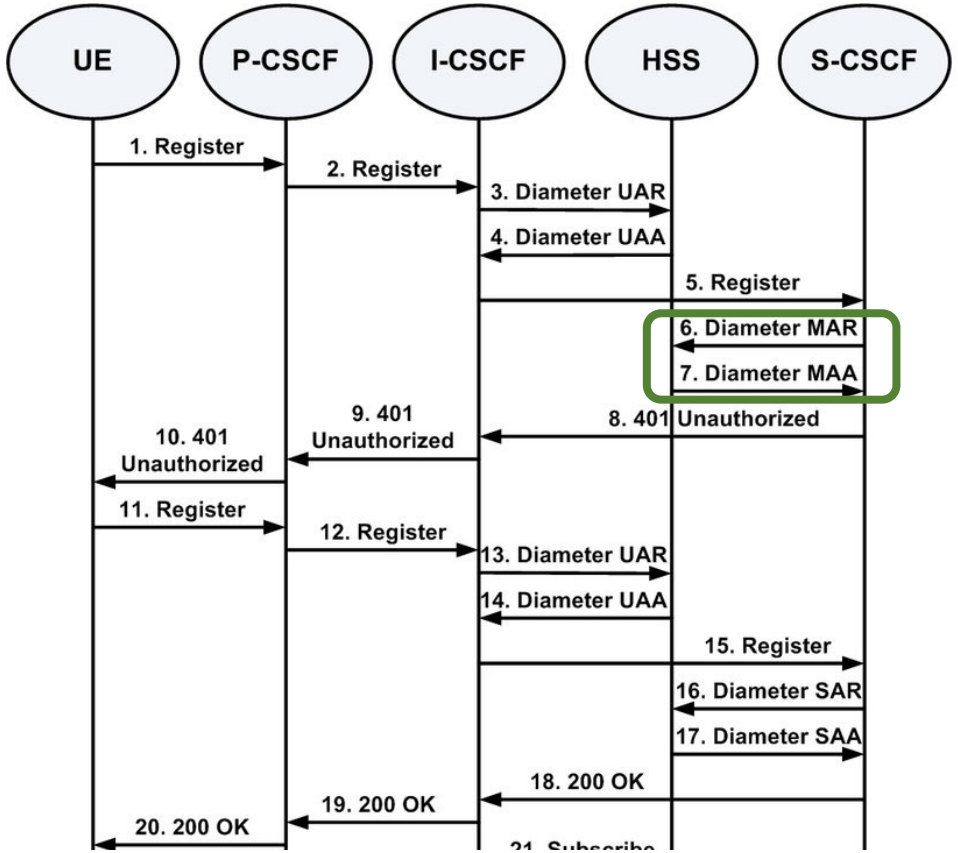
MAR/MAA (S-CSCF <-> HSS)

Registration limits

Authentication Procedure

- MAR : Multimedia Auth. Request
  - Public user identity
  - Private user identity
  - Scscf name from request URI to make HSS aware of SIP server
- MAA: Multimedia Auth. Answer
  - Use parameters in challenge

- Service Control

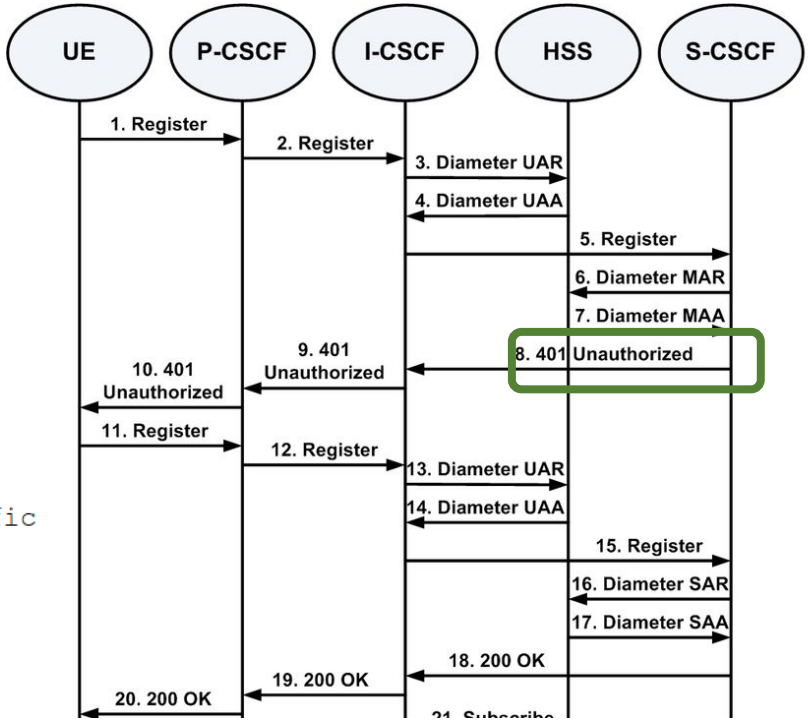


401 Unauthorized response (S-CSCF to I-CSCF)

Add SCSCF address in via header
WWW-Authenticate

Icscf release all registration information

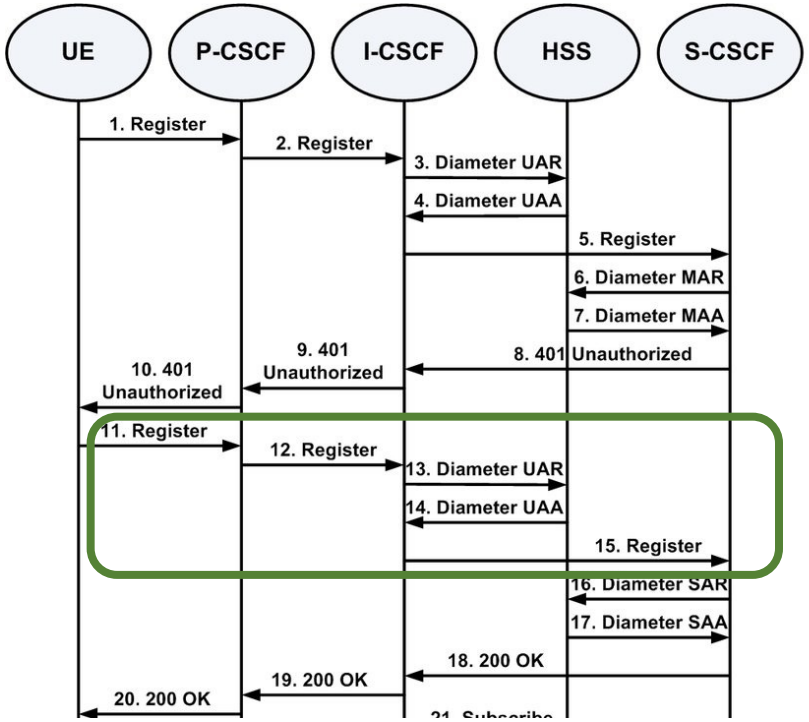
```
SIP/2.0 401 Unauthorized
Via: SIP/2.0/UDP icscf1_p.home1.net;branch=z9hG4bK351g45.1, SIP/2.0/UDP
pcscf1.visited1.net;branch=z9hG4bK240f34.1, SIP/2.0/UDP
[5555::aaa:bbb:ccc:ddd];comp=sigcomp;branch=z9hG4bKnashds7
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>; tag=5ef4
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
```



REGISTER request (UE to P-CSCF)

Generation of response and session keys at UE
Authorization header
UAR/UAA -> no SCSCF selection

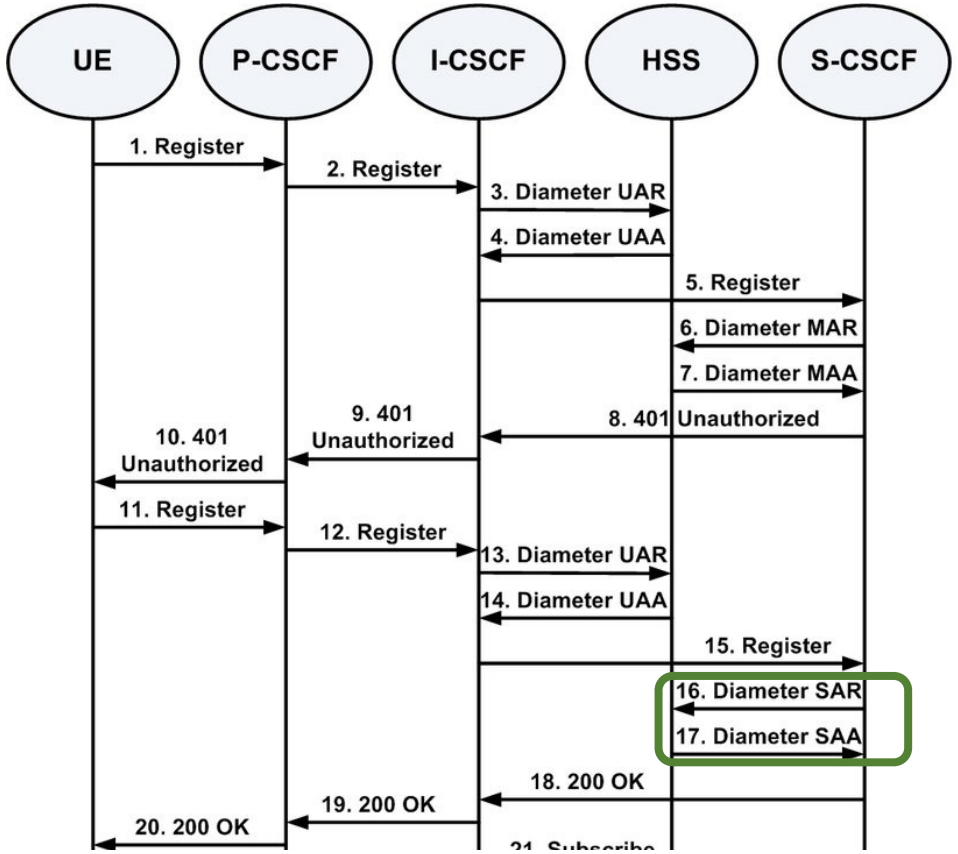
```
REGISTER sip:registrar.home1.net SIP/2.0
Via: SIP/2.0/UDP [5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp;branch=z9hG4bKnashds7
Max-Forwards: 70
P-Access-Network-Info: 3GPP-UTRAN-TDD; utran-cell-id-3gpp=234151D0FCE11
From: <sip:user1_public1@home1.net>;tag=4fa3
To: <sip:user1_public1@home1.net>
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=600000
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-c=23456789; spi-s=12345678; port-c=2468; port-
s=1357
Security-Verify: ipsec-3gpp; q=0.1; alg=hmac-sha-1-96; spi-c=98765432; spi-s=87654321; port-c=8642;
port-s=7531
Require: sec-agree
Proxy-Require: sec-agree
CSeq: 2 REGISTER
Supported: path
```



SAR/SAA (S-CSCF <-> HSS)

Authentication Procedure

- SAR : Server Assignment Request
  - Public user identity
  - Private user identity
  - Scscf name
- SAA: Server Assignment Answer
  - SIP-User-Data AVPs that typically contain the profile of the user, indicating services that the SIP server can provide to that user
- Service Control



200 OK Response(S-CSCF to UE)

Add Service Rout Saved by PCSCF and used in other request
In Rout header from UE
PCSCF subscribe to aware of changes in registration of the UE
Set registration timer in SCSCF and PCSCF

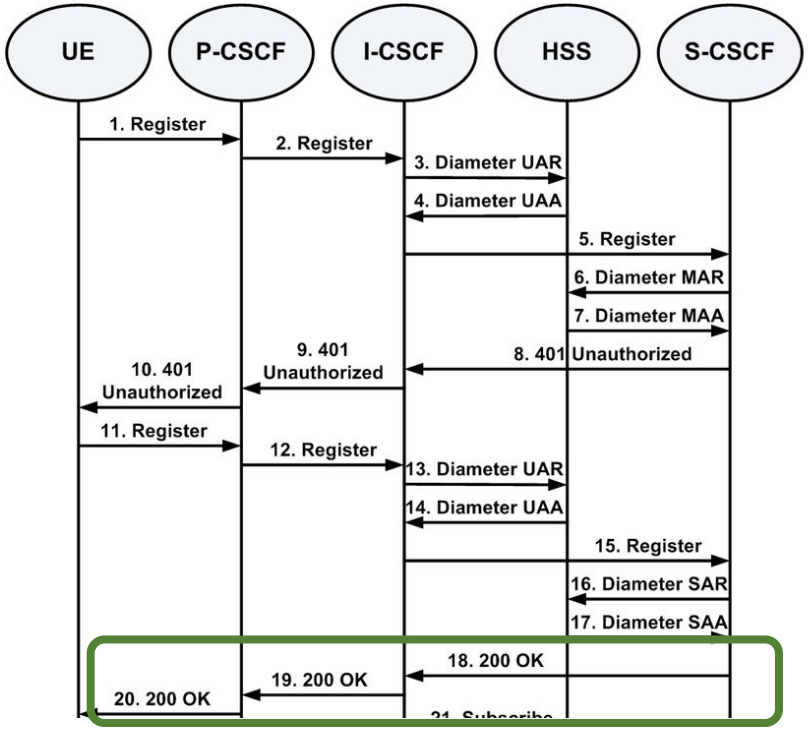


Table 6.2-20: 200 OK response (S-CSCF to I-CSCF)

```
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:orig@scscf1.home1.net;lr>
From:
To:
Call-ID:
Contact: <sip:[5555::aaa:bbb:ccc:ddd]:1357;comp=sigcomp>;expires=600000
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:
```

Re-Registration

- Periodic application level re-registration is initiated by the UE either to refresh an existing registration or in response to a change in the registration status of the UE.
- The UE should perform IMS re-registration when the IP-CAN used by the UE changes between 3GPP access and WLAN access.
- The P-CSCF may force the UE to attempt initial registration with another P-CSCF .
- The S-CSCF shall store the P-CSCF address/name, as supplied by the visited network.
- The HSS shall stores the S-CSCF name .
- Service control (new IP_CAN).
- Restarting registration timer

De-registration

- When the UE wants to de-register from the IMS then the UE shall perform application level de-registration. Deregistration is accomplished by a registration with an expiration time of zero seconds

Via, Rout, Path , Service-Route

- Via is used to route responses whereas Route and Record-Route headers are used to route requests. User agents use Record-Route headers to build Route headers
- The Path header enables the accumulation and transfer of a list of proxies between a SIP UA and a REGISTER.
- The Path header only appears in SIP messages exchanged during the registration process. Inserted by PCSCF
- The S-CSCF stores the contents of the Path header and uses the URI for routing mobile terminated requests.
- The S-CSCF inserts the Service-Route header that includes its own URI including a character string in the user part to differentiate mobile originating requests from mobile terminating requests. /Service-Route: <sip:orig@scscf1.home1.net;lr>
- The P-CSCF saves the value of the Service-Route header and associates it with the UE