



- **P-CSCF**_{1 2 3 4}-CSCF₁ - _{1 2 3 4 5 6 7 8 9 10 11 12}
- **E-CSCF**_{1 2 3}-CSCF₁ - _{1 2 3 4 5 6 7 8 9} P-CSCF_{1 2 3}
- **L-CSCF**_{1 2 3}-CSCF₁ - _{1 2 3 4 5 6 7 8 9}
- **S-CSCF**_{1 2 3}-CSCF₁ - _{1 2 3 4 5 6 7 8 9 10 11 12}

CSCFs

CSCF IMS

1. P-CSCF -

- WiFi P-CSCF
- IPsec
- PCRF QoS
- NAT
- E-CSCF
-

2. L-CSCF -

-
- HSS S-CSCF
- S-CSCF
- /
- NDS/TLS

3. S-CSCF -

-
-
-
- IFC
-
-

OmniCall CSCF 3GPP Diameter IMS

			3GPP
Cx	I-CSCF/S-CSCF ↔ HSS	S-CSCF	TS 29.228
Dx	I-CSCF ↔ SLF	HSS	TS 29.229
Rx	P-CSCF ↔ PCRF	QoS	TS 29.214
Ro	S-CSCF → OCS		TS 32.299
Rf	S-CSCF → CDR		TS 32.299
ISC	S-CSCF ↔ AS		TS 23.228
Sh	AS ↔ HSS		TS 29.328

Diameter Diameter

-  IPsec 
- **QoS**  Rx  PCRf  QoS 
- **NAT**  NAT/  NAT 

- SigComp
-

E-CSCF

- IMS
- E911/E112
- IMEI
- LRF

- LTE/5G VoLTE IPsec
- WiFi VoWiFi IPsec
- SIP
- /DSL

P-CSCF

I-CSCF -

-CSCF

-
- S-CSCF Cx HSS S-CSCF
- S-CSCF S-CSCF
- S-CSCF
- NDS/TLS

- S-CSCF S-CSCF
- S-CSCF
-
- Dx HSS

-
- S-CSCF
-
- MVNO

L-CSCF

S-CSCF -

-CSCF IMS

-
-
- IFC
- SIP
- OCS CDF

IFC S-CSCF HSS XML OmniTAS OmniMessage SMS/MMS

- SIP URI/
- IFC
- AS OmniTAS → OmniMessage
- AS

-
-
-
-
-
-
-

-
-
-
- I-CSCF

S-CSCF

Diameter

OmniCall CSCF Diameter CSCF

Diameter

3GPP Cx Cx 16777216 ID I-CSCF, S-CSCF

3GPP Dx	Dx 16777216	I-CSCF	HSS
3GPP Rx	Rx 16777236	P-CSCF	QoS
3GPP Ro	Ro 4 (CC)	S-CSCF	
3GPP Rf	Rf 3 (Accounting)	S-CSCF	CDR
3GPP Sh	Sh 16777217	AS	

Diameter

- DNS
-
-
-
-

Diameter [Diameter](#)

OmniCall CSCF Web

IMS

IMS

- P-CSCF P-CSCF IPsec/SIP
- S-CSCF HSS IMS

- P-CSCF S-CSCF
- IMPU IMSI IP
-
-
-

- [P-CSCF](#)
- [S-CSCF](#)








S-CSCF IMS

- ID
- SDP
-
-

- 
- 
- 

S-CSCF

◆◆◆◆◆ IFC ◆◆








IFC


S-CSCF



























OmniTAS


IFC   

- [illegible]

IFC

```
<InitialFilterCriteria>
  <Priority>10</Priority>
  <TriggerPoint>
    <SPT><Method>INVITE</Method></SPT>
    <SPT><SessionCase>0</SessionCase><!-- 2 2 --></SPT>
  </TriggerPoint>
  <ApplicationServer>
    <ServerName>sip:omnitas.ims.example.com</ServerName>
    <DefaultHandling>0</DefaultHandling><!-- 2 2 2 2 -->
  </ApplicationServer>
</InitialFilterCriteria>
```

 IFC
 S-CSCF IFC

Diameter

Diameter

OmniCall CSCF Diameter HSSPCRF

- I_Open = Closed =
- Diameter
- /
-

Diameter

- Cx HSSI-CSCFS-CSCF
- Rx PCRF P-CSCF QoS
- Ro OCS S-CSCF

Diameter Diameter

E-CSCF

- IMEI
- E911/E112
- PSAP
-

-
- SIM/
-

P-CSCF

CSCF

imei_msisdn CSCF TTL
P-CSCF 24

- [P-CSCF](#)    
- [I-CSCF](#)    
- [S-CSCF](#)    

              4xx/5xx SIP  

1.     

-                IMS  
-   [S-CSCF](#)      

2. **IFC**/     

-    HSS    IFC   SAR/SAA 
-           IFC  
-   OmniTAS/OmniMessage          

3. **QoS/PCRF**  

-   P-CSCF   Rx Diameter    
-   PCRF QoS    
-               

4.    

-         ENUM      
-   PSTN      /MGCF  
-             

Diameter

   Diameter    “ ”      

1.                 Diameter   
2.           Diameter    IP      3868 
3.                ID   
4.         Diameter     DWR/DWA   

  **Diameter**   

Cx HSS IFC -
 Rx PCRF QoS -
 Ro OCS -

Diameter Diameter

SMS

SMS IMS SMSC

1. OmniMessage

- IFC OmniMessage MESSAGE
- IFC AS
- SMS IFC

2. SMSC

- OmniMessage SMSC MAP/SMPP
- SIP MESSAGE ↔ SMS PDU
- SMSC

3.

- SIP MESSAGE Content-Type: application/vnd.3gpp.sms
- GSM-7 UCS-2

SMS S-CSCF IFC

PSAP

1. E-CSCF

- URN urn:service:sos
- P-CSCF
- LRF

2.

- SIP INVITE
- IMEI
- LRF

3. PSAP

- PSAP
- ESQK
- PSAP

[P-CSCF](#)

1. **Prometheus** CSCF
2. S-CSCF
3. CSCF
4. CSCF CPU

- **P-CSCF** ~50,000 IPsec SAs VoLTE OmniePDG VoWiFi
- **I-CSCF** 1,000-5,000
- **S-CSCF** 100,000-500,000 20,000-100,000

[P-CSCF](#)

[Web UI](#)

CSCF

- [P-CSCF/E-CSCF](#) -
- [I-CSCF](#) - S-CSCF
- [S-CSCF](#) - IFC
- [Diameter](#) - Diameter
- [Web UI](#) -
- - P-CSCF I-CSCF S-CSCF Prometheus
- -

IR.94 - IMS SMS VoWiFi

GSMA PRD IR.94 IR.92 WiFi

OmniCall VoWiFi

VoWiFi

- **OmniePDG** - WiFi IPsec
- **OmniCall P-CSCF** VoLTE VoWiFi IFC
- LTE WiFi

IR.94

- IR.92 VoWiFi
- DNS ePDG
- IMS VoLTE VoWiFi
- DAS

ePDG VoWiFi [OmniePDG](#)

GSMA

- **IR.51** - GSMA
- **IR.88** - LTE
- **AA.80** - IMS/RCS

OmniCall CSCF

✓ GSMA IR.92/IR.94 - iPhone Android

✓ **IMS** CSCF P/I/S/E VoWiFi OmniePDG

IMS VoLTE/VoWiFi

✓ DNS DHCP SIM
IT

✓ Web

✓

✓ OmniTAS OmniMessage SMS/MMS

- ✓ E-CSCF E911/E112
- ✓ 3GPP GSMA
- ✓ Tier-1 Tier-2 MVNO

IMS

- 3GPP -
- AKA - IMS
- AoR - SIP sip:user@domain.com
- CSCF - IMS
- DAS -
- E-CSCF CSCF -
- ePDG - WiFi IPsec
- ENUM E.164 - DNS
- ESQK -
- FMC -
- GSMA GSM -
- HD Voice - AMR-WB
- HSS -
- I-CSCF CSCF -
- IFC - XML
- IMS IP - 3GPP IP
- IMPU IP - SIP URI tel URI
- IMSI -
- IR.92 GSMA SMS IMS - VoLTE
- IR.94 GSMA SMS IMS - VoWiFi
- ISC IMS - S-CSCF
- LRF -
- MGCF - PSTN
- MVNO -
- NDS - TLS/IPsec
- P-CSCF CSCF -
- PSAP -
- RCS -
- S-CSCF CSCF -
- SPT - IFC URI
- SWu UE ePDG 3GPP IPsec/IKEv2
- UE -
- VoLTE LTE - LTE
- VoWiFi WiFi - WiFi

Diameter

- **AAA**
- **AVP** - Diameter
- **CCR/CCA** -
- **CDF** -
- **Cx**I-CSCF/S-CSCF HSS Diameter
- **Diameter** IMS AAA RADIUS
- **Dx**I-CSCF SLF Diameter
- **DWR/DWA** -
- **MAR/MAA** -
- **OCS** -
- **PCRF** - QoS
- **Rf** Diameter
- **Ro** Diameter
- **Rx**P-CSCF PCRF Diameter QoS
- **SAR/SAA** -
- **Sh**AS HSS Diameter
- **SLF** - HSS HSS
- **UAR/UAA** - S-CSCF

OmniCall

- **OmniCall CSCF** IMS CSCF
- **OmniePDG** - VoWiFi IPsec IR.94
- **OmniTAS** -
- **OmniMessage** - IMS SMS/MMS TS 24.341

SIP

- SIP
- **INVITE** SIP
- **MESSAGE** SIP IMS SMS
- **REGISTER** SIP
- **SDP** -
- **SIP** - IMS



Diameter



1. [IMS](#)
2. [IMS Diameter](#)
3. [Diameter](#)
4. [Web UI](#)
5. [Diameter](#)
6. [Diameter](#)



Diameter IMS AAA OmniCall CSCF
Diameter HSS PCRF OCS

Diameter

Diameter (RFC 6733) RADIUS AAA

- TCP/SCTP RADIUS UDP
-
- -
-
-

Diameter CSCF

CSCF Diameter

CSCF ID
I-CSCF Cx 16777216 HSS S-CSCF
S-CSCF Cx 16777216 HSS
S-CSCF Sh 16777217 HSS
P-CSCF Rx 16777236 PCRF QoS
S-CSCF Ro 4 OCS
S-CSCF Rf 3 CDF

IMS Diameter






Diameter

C_x $\diamond\diamond$ (CSCF $\leftrightarrow$ HSS)

Cx I-CSCF S-CSCF

3GPP : TS 29.228

I-CSCF

◆◆◆◆◆◆ (UAR) / ◆◆◆◆◆◆ (UAA):

- 2^2 : 2^2 HSS 2^3 S-CSCF 2^4
- 2^2 : 2^3 REGISTER
- 2^2 : I-CSCF 2^3 2^3 2^3 2^3 S-CSCF

◆◆◆◆◆ (LIR) / ◆◆◆◆◆ (LIA):

- 2:2: HSS 22222222 S-CSCF
- 2:2: 22222222 INVITE MESSAGE
- 2:2: I-CSCF 222222222222 S-CSCF

S-CSCF

◇◇◇◇◇◇◇ (MAR) / ◇◇◇◇◇◇◇ (MAA):

- $\diamond \diamond$: $\diamond$ HSS $\diamond \diamond \diamond \diamond \diamond \diamond$
- $\diamond \diamond$: $\diamond \diamond$ REGISTER $\diamond \diamond \diamond \diamond \diamond \diamond \diamond$
- $\diamond \diamond$: S-CSCF $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$ IMS AKA $\diamond \diamond$

◇◇◇◇◇◇◇ (SAR) / ◇◇◇◇◇◇◇ (SAA):

- $\diamond\diamond$: $\diamond\diamond$ HSS $\diamond\diamond\diamond\diamond\diamond\diamond\diamond\diamond\diamond\diamond\diamond$
- $\diamond\diamond$: $\diamond\diamond\diamond\diamond\diamond$ MAR/MAA $\diamond\diamond$
- $\diamond\diamond$: S-CSCF $\diamond\diamond\diamond\diamond\diamond$ IFC $\diamond\diamond\diamond\diamond\diamond\diamond$

SAA User-Data AVP

- $\diamond \diamond \diamond \diamond$
- $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$ (IFC)
- $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$
- $\diamond \diamond \diamond \diamond$

◆◆◆◆◆ (RTR) / ◆◆◆◆◆ (RTA):

- ◆◆: HSS ◆◆◆◆◆ HSS ◆◆◆◆
- ◆◆: ◆◆◆◆◆
- ◆◆: HSS ◆◆ S-CSCF ◆◆◆◆

Rx ◆◆ (P-CSCF ↔ PCRF)

Rx ◆◆◆ IMS ◆◆◆◆◆ QoS ◆◆◆

3GPP ◆◆: TS 29.214

AA ◆◆ (AAR) / AA ◆◆ (AAA):

- ◆◆: ◆◆◆◆◆ QoS ◆◆
- ◆◆: ◆ SIP INVITE ◆◆◆ SDP ◆◆/◆◆◆◆
- ◆◆: P-CSCF ◆◆ PCRF ◆◆◆◆◆

◆◆◆◆◆ (RAR) / ◆◆◆◆◆ (RAA):

- ◆◆: PCRF ◆◆◆◆◆ PCRF ◆◆◆◆
- ◆◆: ◆◆◆◆◆
- ◆◆: PCRF ◆◆ P-CSCF ◆◆ QoS ◆◆

◆◆◆◆◆ (STR) / ◆◆◆◆◆ (STA):

- ◆◆: ◆◆ Rx ◆◆◆◆◆
- ◆◆: ◆◆◆◆◆ BYE ◆
- ◆◆: P-CSCF ◆◆ PCRF ◆◆ QoS ◆◆

Ro ◆◆ (S-CSCF ↔ OCS)

Ro ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆

3GPP ◆◆: TS 32.299

◆◆◆◆◆ (CCR) / ◆◆◆◆◆ (CCA):

- ◆◆: ◆◆◆◆◆◆◆◆
- ◆◆: ◆◆◆◆◆◆◆◆◆◆◆◆◆◆
- ◆◆: ◆◆◆◆◆◆◆◆◆◆◆◆◆◆

◆◆◆

- CCR-◆◆:** ◆◆◆◆◆◆◆◆◆◆
- CCR-◆◆:** ◆◆◆◆◆◆◆◆◆◆
- CCR-◆◆:** ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆

Web UI

OmniCall CSCF Web Diameter

: Diameter (http://<cscf-server>:4000/diameter)

Diameter

- : Diameter
- : Diameter Origin-Host
- :
- : CDP
- :
- :
- :
- :

Diameter

FQDN

I_Open Closed

Diameter

:

- 1.
- 2.
- 3.

:

- 1.
- 2.
- 3.
- 4.

◆ ◆ ◆ ◆ ◆ ◆ :

- 1.
2. Diameter

 Diameter

- **16777216:10415** - 3GPP Cx/Dx (HSS $\diamond$ I-CSCF/S-CSCF $\diamond\diamond\diamond$)
- **16777236:10415** - 3GPP Rx (PCRF QoS $\diamond\diamond\diamond\diamond$ P-CSCF)
- **16777238:0** - 3GPP Ro ($\diamond\diamond\diamond\diamond$)
- $\diamond\diamond\diamond\diamond\diamond\diamond\diamond\diamond$ ID $\diamond\diamond\diamond\diamond$ ID

? ? ? ? ? ? ? Diameter ? ? ? ? ID ? ? ? 3GPP ? ? ? ? ?
? ? ? ? ? ? ? Diameter ? ? ? ? ID ? ? ? 3GPP ? ? ? ? ?

- **Cx/Dx** (16777216:10415)
- **Sh/Dh** (16777217:10415)
- **Rx** (16777236:10415)
- **Ro** (16777238:10415/0/5535/13019)
- **Gx** (16777224:10415)
- **S6a/S6d** (16777251:10415)
-         diameter_live.exe       

◆ ◆ ◆ ◆

[illegible]

◆◆◆◆◆◆◆◆◆◆: ◆◆◆ [Web UI](#) ◆◆◆◆

Diameter



2xxx	2001 DIAMETER_SUCCESS		
3xxx	3002 DIAMETER_UNABLE_TO_DELIVER		
	3003 DIAMETER_REALM_NOT_SERVED		
	3007 DIAMETER_APPLICATION_UNSUPPORTED		Application-Id
4xxx			

- Diameter Application-Id
- CSCF
- CSCF

HSS Cx

: MAR/MAA

:

4010	USER_UNKNOWN	HSS	
4001	AUTHENTICATION_REJECTED	IMPI/	
5012	UNABLE_TO_COMPLY	HSS	HSS

:

- **USER_UNKNOWN:** HSS
- **AUTHENTICATION_REJECTED:** HSS IMPI
- **UNABLE_TO_COMPLY:** HSS

PCRF Rx

: QoS AAR/AAA

:

- **PCRF**: Web UI
- **Framed-IP-Address**: PCRF UE IP
- : PCRF PCEF

:

- PCRF "I_Open"
- PCRF UE IP
- Gx PCRF PCEF

OCS Ro

: CCR/CCA

:

4012 CREDIT_LIMIT_REACHED
5003 AUTHORIZATION_REJECTED

◆◆◆◆:

- **CREDIT_LIMIT_REACHED:**
 - **OCS** : OCS
 - **AUTHORIZATION_REJECTED:** OCS
-

◆◆◆◆

◆◆: Diameter

◆◆:

1. " " " "
2. " " " "
3. CSCF

◆◆◆◆:

- : CSCF
- : HSS/PCRF/OCS
- : " " " " " " " " " " " "

◆◆◆◆

◆◆◆◆

◆◆◆◆:

- Web UI
-
-

◆◆◆◆:

- Diameter
- HSS/PCRF/OCS
- Diameter (DRA)

◆◆◆◆:

-
- Diameter SIP Call-ID

- **CSCF** **Diameter**

:

- **TLS** **Diameter**
- **Diameter**
- **/**

- **/**
- **/**
- **ID**
- **5**

- **Diameter** **Diameter** **AVP**
- **Diameter** **Grafana**
- **:**
- **DWR/DWA**
- **Web UI**

CSCF **Diameter**

Prometheus **CDP/Diameter**
Web UI

Web UI

- **P-CSCF** - P-CSCF Rx
- **I-CSCF** - I-CSCF Cx
- **S-CSCF** - S-CSCF CxRo
- **Web UI** - **Diameter**
- **CSCF** - **CSCF**

3GPP

- TS 29.228: Cx Dx (CSCF-HSS)
- TS 29.214: Rx (P-CSCF-PCRF)
- TS 32.299: Diameter (Ro, Rf)
- RFC 6733: Diameter

- Diameter: Diameter
- : RPC CSCF
- Web UI: Phoenix LiveView (lib/cscf_web/web/diameter_live.ex)

Diameter CSCF
/



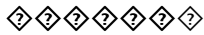
OmniCall CSCF



OmniCall CSCF - 100 S-CSCF 3-4 S-CSCF



OmniCall CSCF - 100 S-CSCF 3-4 S-CSCF



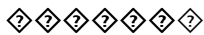
✓ 100 S-CSCF 3-4 S-CSCF

✓ P-CSCF I-CSCF S-CSCF

✓ I-CSCF S-CSCF DNS P-CSCF I-CSCF

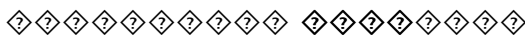
✓ CSCF

✓ CSCF



- 10K 1 P-CSCF 1 I-CSCF 1 S-CSCF
- 50K 2 P-CSCF 2 I-CSCF 2 S-CSCF
- 200K 6 P-CSCF 4 I-CSCF 4 S-CSCF
- 1M 30 P-CSCF 10 I-CSCF 10 S-CSCF
- 10M 300 P-CSCF 50 I-CSCF 50 S-CSCF

100 S-CSCF 3-4 S-CSCF



- 100 S-CSCF 3-4 S-CSCF
- IFC
- 100 S-CSCF 3-4 S-CSCF
- 100 S-CSCF 3-4 S-CSCF

?? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?

- ? ? ? ? ? CPU ? ? ? RAM ? ? ? ? ? ?
- IFC ? ? ? ? ? ? ? ? ? ? ? ?
- ? ? ? ? ? ? ? ? ? ? = ? ? ? ? ? ? ? ? ? ?
- ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?

?? ?

??

1. [? ? ? ?](#)
2. [P-CSCF](#) ? ?
3. [I-CSCF](#) ? ?
4. [S-CSCF](#) ? ?
5. [? ? ? ?](#)
6. [? ? ? ?](#)
7. [? ? ? ? ?](#)
8. [? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?](#)

?? ? ? ?

?? ? ? ? ? ?

CSCF	??	?? ? ?	?? ? ? ? ? ? ? ?	?? ? ? ?
P-CSCF	IPsec	?? ? ?	~50,000 UEs	10,000-30,000 UEs
I-CSCF	CPU/	?? ? ? ? ? ? ?	?? ? ? ? ? ?	100,000+ req/sec
S-CSCF	?? ? ? ?		~500,000 IMPUs	100,000-300,000 IMPUs
?? ?	?? ? ? ? ? ?		~100,000	?? 20,000-50,000

?? ? ? ? ? ? ? ? ? ? ?

OmniCall CSCF ?

??	?	??	?? ? ? ?
SPI	??	10,000	IPsec SPI
??	??	?? ? ? ? ? ?	?? ? ? ? ? ? ? ? 10K
??	??	?? ? ? ? ? ?	40K-50K
??	??	?? ? ? ? ? ?	P-CSCF
??	??	?? ? ? ? ? ?	1-5
IMPUs	??	100	SIP
?? ?	??	??	S-CSCF
?? ? ?	?? ? ? ?	?? ? ? ?	1-3
??	10	??	?? ? ? ? ? ?

NOTIFY 16 KB S-CSCF

SPI

- 10,000 SPI
- P-CSCF 40,000-50,000
- SPI IPsec SA
- P-CSCF

P-CSCF

-CSCF IPsec

1. IPsec

UE

- IPsec SA
- SPI ~200
- ~1-2 KB
- ~500-1000
- UE ~2-3 KB

- 40,000-50,000 UEs SPI
- 20,000-30,000 UEs
- 10,000-15,000 UEs

- 100K DNS 3-5 P-CSCF
- 500K 15-25 P-CSCF
- 1M+ 30-50+ P-CSCF

40K+ UEs P-CSCF

I-CSCF

4 vCPU 8 GB RAM

	1,000 reg/sec	2,000 reg/sec	5,000 reg/sec
10K	1	1	1
100K	2	1	1
500K	4	2	1

DNS I-CSCF

S-CSCF

-CSCF

1.

IMPU

- IMPU
- ~1-2 KB IMPU
- IFC ~5-20 KB HSS
- ~1-2 KB
- IMPU ~7-25 KB

- 400,000-500,000 IMPUs hash_size=14+
- 200,000-300,000 IMPUs IFC
- 100,000-150,000 IMPUs IFC AS

- 1M 3-5 S-CSCF I-CSCF HSS
- 5M 15-25 S-CSCF
- 10M+ 30-50+ S-CSCF

IFC AS
400K+ IMPUs

$\diamond \diamond$	$\diamond \diamond \diamond \diamond \diamond \diamond$	$\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$	$\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$
$\diamond \diamond$	IMPUs	$\diamond \diamond$	
$\diamond \diamond$	100,000-150,000	20,000-30,000	$10K \diamond \diamond = 1 \diamond \diamond \diamond \diamond$ $500K \diamond \diamond = 4 \diamond \diamond \diamond$
$\diamond \diamond$	200,000-300,000	40,000-60,000	$10K \diamond \diamond = 1 \diamond \diamond \diamond \diamond$ $500K \diamond \diamond = 2 \diamond \diamond \diamond$
$\diamond \diamond$	400,000-500,000	80,000-100,000	$10K \diamond \diamond = 1 \diamond \diamond \diamond \diamond$ $500K \diamond \diamond = 1 \diamond \diamond \diamond$
			$100K \diamond \diamond = 1 \diamond \diamond \diamond \diamond$ $100K \diamond \diamond = 1 \diamond \diamond \diamond \diamond$ $100K \diamond \diamond = 1 \diamond \diamond \diamond \diamond$

P-CSCF	25	8 vCPU	8 GB RAM	20,000 UEs
I-CSCF	4	4 vCPU	8 GB RAM	2,000 reg/sec
S-CSCF	4	8 vCPU	8 GB RAM	150,000 IMPUs
33				
500,000				

P-CSCF	15	8 vCPU	8 GB RAM	33,000 UEs
I-CSCF	2	4 vCPU	8 GB RAM	5,000 reg/sec
S-CSCF	2	8 vCPU	8 GB RAM	250,000 IMPUs
19				
				500,000

P-CSCF	10	8 vCPU	8 GB RAM	50,000 UEs
I-CSCF	1	4 vCPU	8 GB RAM	5,000 reg/sec
S-CSCF	1	8 vCPU	8 GB RAM	500,000 IMPUs
12				
				500,000

-  P-CSCF
-  DNS  BGP Anycast  I-CSCF
-  S-CSCF  I-CSCF 

OmniePDG

- ◆ ◆ ◆

VoWiFi UE → (IPsec) → OmnicorePDG → (SIP) → P-CSCF → I-CSCF → S-CSCF
VoLTE UE → (IPsec) → P-CSCF → I-CSCF → S-CSCF

VoWiFi >50K OmniePDG P-CSCF
IPsec

OmniCall CSCF OmniCall

OmniCall CSCF

- Linux
-
- TCP/IP SIP Diameter

OmniCall

-
-
- IFC
-

KPI

P-CSCF

IPsec SA		> 25,000	> 40,000
SPI	SPI	> 70%	> 90%
REGISTER	/	> 100/sec	> 500/sec
		> 20	> 50
		> 70%	> 90%

Prometheus

```
# IPsec SA
ipsec_sa_count{cscf="pcscf01"}

#
```

```
rate(sip_register_requests_total{cscf="pcscf01"}[5m])
```

S-CSCF

IMPUs	> 300,000	> 450,000
	> 40,000	> 70,000
IMPUs	> 50	> 100
	> 10	> 20
IFC	> 10 ms	> 50 ms

Prometheus

```
# impu_registered_count{cscf="scscf01"}  
  
# dialog_active_count{cscf="scscf01"}
```

I-CSCF

TPS REGISTER	> 1,000/sec	> 2,000/sec
HSS Cx Diameter	> 50 ms	> 200 ms
HSS HSS	> 1%	> 5%

OmniCall CSCF Prometheus <http://<host>:9090/metrics>

- IPsec SA P-CSCF
- P-CSCF S-CSCF
- S-CSCF
- CPU

Prometheus/Alertmanager

```
groups:  
- name: cscf_capacity  
  rules:  
  - alert: PCSCFIPsecSAHigh  
    expr: ipsec_sa_count > 40000
```

```

for: 5m
annotations:
  summary: "P-CSCF {{ $labels.instance }} IPsec SA"

- alert: SCSCFRegistrationHigh
  expr: impu_registered_count > 450000
  for: 10m
  annotations:
    summary: "S-CSCF {{ $labels.instance }}"

- alert: SCSCFDialogHigh
  expr: dialog_active_count > 70000
  for: 5m
  annotations:
    summary: "S-CSCF {{ $labels.instance }}"

```

?

?

1. OmniCall CSCF 5K 500K+
- 2.
3. **3GPP** 3GPP IMS
4. CSCF

?

?

?

- 1.
- 2.

?

3. OmniCall CSCF
 - MVNO 3-5 5K-10K
 - 10-30 50K-200K

- 100+ 1M+

4.

5.

-
-
-
-
-

3 10K 1M

		P-CSCFI-CSCFS-CSCF			
0	10,000	1	1	1	3
1	50,000	2	2	2	3
1.5	100,000	4	3	3	4
2	250,000	8	4	5	6
3	500,000	15	6	8	13
	1,000,000	30	10	10	24

P-CSCF

- IPsec SA >30K >70%
- CPU >70%
- >500ms

S-CSCF

- IMPU >250K >70%
- 50K
- CPU >70%

I-CSCF

- >2,000/sec
- CPU >80%
- HSS

1-2

- 1.
- 2.
- 3.
4. 80%
- 5.



I-CSCF



1. [IMS](#)
2. [IMS](#)
3. [I-CSCF](#)
4. [Web UI](#)
5. [IMS](#)
6. [IMS](#)



I-CSCF IMS P-CSCF HSS S-CSCF

3GPP

- **3GPP TS 23.228** IP IMS
- **3GPP TS 24.229** IMS
- **3GPP TS 29.228** Cx I-CSCF HSS
- **3GPP TS 29.229** Cx



1. **HSS** HSS S-CSCF
2. **S-CSCF** S-CSCF
3. S-CSCF
4. S-CSCF
5. S-CSCF
6. SIP



- Diameter HSS Cx
- S-CSCF
- SIP

IMS

3GPP

IMS P-CSCF/I-CSCF P-CSCF, IMS
IMS I-CSCF S-CSCF S-CSCF
Cx Diameter HSS

I-CSCF

1. HSS Cx

I-CSCF Diameter Cx HSS

UAR

REGISTER S-CSCF

-
- S-CSCF
- S-CSCF

Diameter

```
UAR (User-Authorization-Request)
  Session-Id
  Vendor-Specific-Application-Id
    Vendor-Id: 10415 (3GPP)
    Auth-Application-Id: 16777216 (Cx)
  Auth-Session-State: NO_STATE_MAINTAINED
  Origin-Host: icscf.ims.mnc001.mcc001.3gppnetwork.org
  Origin-Realm: ims.mnc001.mcc001.3gppnetwork.org
  Destination-Realm: ims.mnc001.mcc001.3gppnetwork.org
  User-Name: sip:user@ims.mnc001.mcc001.3gppnetwork.org
  Public-Identity: sip:user@ims.mnc001.mcc001.3gppnetwork.org
  Visited-Network-Identifier: ims.mnc001.mcc001.3gppnetwork.org
  UAR-Flags: 0
```

HSS UAA

UAA (User-Authorization-Answer)

Result-Code: 2001 (DIAMETER_SUCCESS)
Experimental-Result-Code: 2001 (FIRST_REGISTRATION)
Server-Name: sip:scscf.ims.mnc001.mcc001.3gppnetwork.org
Server-Capabilities:
Mandatory-Capability: 1
Optional-Capability: 2
Server-Name: sip:scscf-backup.ims.mnc001.mcc001.3gppnetwork.org

◆◆◆◆◆

- 2001: ◆◆◆◆◆◆◆◆◆◆
- 5003: ◆◆◆◆◆
- 5004: ◆◆◆◆◆
- 5042: ◆◆◆◆◆ S-CSCF

◆◆◆◆◆◆◆LIR◆

◆◆ INVITE ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆ S-CSCF◆

◆◆◆

- ◆◆◆◆◆◆◆◆◆◆ S-CSCF
- ◆◆◆◆◆◆◆◆◆◆

Diameter ◆◆◆

LIR (Location-Info-Request)
Session-Id
Vendor-Specific-Application-Id
Vendor-Id: 10415 (3GPP)
Auth-Application-Id: 16777216 (Cx)
Auth-Session-State: NO_STATE_MAINTAINED
Origin-Host: icscf.ims.mnc001.mcc001.3gppnetwork.org
Origin-Realm: ims.mnc001.mcc001.3gppnetwork.org
Destination-Realm: ims.mnc001.mcc001.3gppnetwork.org
Public-Identity: sip:user@ims.mnc001.mcc001.3gppnetwork.org
Originating-Request: 0 # 0=terminating, 1=originating

HSS ◆◆◆LIA◆◆

LIA (Location-Info-Answer)
Result-Code: 2001 (DIAMETER_SUCCESS)
Server-Name: sip:scscf.ims.mnc001.mcc001.3gppnetwork.org

◆◆◆◆◆

- 2001: ◆◆◆◆◆◆◆◆◆◆ S-CSCF◆
- 5401: ◆◆◆◆◆◆◆

- 5003:

2. S-CSCF

 HSS       S-CSCF         I-CSCF              

- [illegible]

S-CSCF

I-CSCF 

S-CSCF **S-CSCF**

- **ID** S-CSCF “ S-CSCF”
- **S-CSCF URI** SIP URI
sip:scscf.ims.mnc001.mcc001.3gppnetwork.org:5060;transport=tcp

S-CSCF **S-CSCF**

- **ID** 
- **S-CSCF ID**  S-CSCF
-  S-CSCF  ID

- S-CSCF #1 "S-CSCF" URI
sip:scscf.ims.mnc001.mcc001.3gppnetwork.org:5060
 - 0
 - 1

 S-CSCF Web UI $\rightarrow$ I-CSCF $\rightarrow$ S-CSCF

S-CSCF S-CSCF

◆ ◆ ◆ ◆

S-CSCF **I-CSCF** **S-CSCF**

1. HSS UAA

AVP 000

2. 00000000000000000000000000000000 S-CSCF 000

3. 00000

- 00000000 S-CSCF000 URI 000 \$avp(scscf_uri) 00000000000000000000000000000000 URI (\$du)
- 000000000000 S-CSCF000000000000 503 000000

3. 00000

I-CSCF 000000000000 S-CSCF 0000000000000000

1. 00 **Record-Route**0000 Record-Route 0
2. 000000000000 S-CSCF 0 Via 0
3. 000000000000 I-CSCF 00 S-CSCF 00
4. 000000000000000000000000

000

000000

Via: SIP/2.0/UDP icscf.example.com:5060

000000

Via: SIP/2.0/UDP scscf.example.com:5060

Via: SIP/2.0/UDP icscf.example.com:5060

4. 00000

REGISTER 00

INVITE 0000000

5. NDS00000000

I-CSCF 00000 00000 00000000000000000000000000000000

00

- **ID**0000000000000000
- 0000000000000000 "ims.mnc001.mcc001.3gppnetwork.org"0

000000 0000000000000000 IMS 000000000000000000

- ims.mnc001.mcc001.3gppnetwork.org00000000
- ims.mnc002.mcc001.3gppnetwork.org000000000000

I-CSCF S-CSCF

Web UI → I-CSCF → S-CSCF

Web UI

I-CSCF

https://<control-panel>/icscf

I-CSCF

1. **S-CSCF** - S-CSCF
2. **NDS** -
3. - S-CSCF I-CSCF
4. -

S-CSCF

S-CSCF

- **ID** ID
-
- **S-CSCF URI** S-CSCF SIP URI
- ID

ID	S-CSCF URI
1	S-CSCF sip:scscf.ims.mnc001.mcc001.3gppnetwork.org:5060 0, 1
2	S-CSCF sip:scscf2.ims.mnc001.mcc001.3gppnetwork.org:5060 0, 1

- S-CSCF
-
- S-CSCF URI

/ S-CSCF S-CSCF

- “ S-CSCF”

- S-CSCF URI sip:scscf3.example.com:5060;transport=tcp
- ID 0 1

NDS

- ID ID
- FQDN

ID	
1	ims.mnc001.mcc001.3gppnetwork.org
2	ims.mnc002.mcc001.3gppnetwork.org
3	carrier.example.com

-
-

FQDN partner.example.com

I-CSCF S-CSCF

- ID SIP ID
-
- S-CSCF S-CSCF
-
- UAR/LIR Diameter
-

1. S-CSCF
- 2.
3. S-CSCF
- 4.

- **S-CSCF**
- 2. **HSS UAA**
- 3. **HSS I-CSCF**
- 4.
 -
 - **S-CSCF**
 - **HSS**

S-CSCF

S-CSCF

-
-
- **HSS**

1.
 - **I-CSCF** →
 - **S-CSCF**
2. **HSS S-CSCF**
3. **I-CSCF S-CSCF HSS**
- 4.

S-CSCF

I-CSCF

- 1.
2. **S-CSCF URI**
3. **S-CSCF**

4. S-CSCF

5.

S-CSCF I-CSCF

Wireshark I-CSCF

-
- Via
- Record-Route

1.

2. Via

3.

-
- SIP

"

- -
 -
 - I-CSCF

SQL

- - s_cscf s_cscf_capabilities nds_trusted_domains

-    
-             

1. **I-CSCF**

-   DNS SRV     
-         HSS
-       S-CSCF    

2. **DNS SRV**

```
_sip._udp.ims.example.com. SRV 10 50 5060 icscf01.example.com.
_sip._udp.ims.example.com. SRV 10 50 5060 icscf02.example.com.
_sip._tcp.ims.example.com. SRV 10 50 5060 icscf01.example.com.
_sip._tcp.ims.example.com. SRV 10 50 5060 icscf02.example.com.
```

3. I-CSCF

1.

- children=64      I-CSCF        
- tcp_children=8    TCP  

2.

3.

-    RTP  I-CSCF    
-      
-                   

4. **Diameter** Cx

- sessions_hash_size=4096               
- workers=4    Diameter        Cx  

1. Via/P-Visited-Network-ID

2. IP UAR/LIR HSS DoS

- `pike`
- `503`
- `HSS`

3. **HSS** `TLS` `TLS` `Diameter` `DTLS`

4. `P`

1.

- `UAR`
- `LIR`
-
- `S-CSCF`
- `Diameter`

2. **Prometheus**

```
# UAR
rate(icscf_uar_success[5m]) / rate(icscf_uar_total[5m])

# Diameter
rate(diameter_request_duration_sum[5m]) /
rate(diameter_request_duration_count[5m])
```

3.

- `HSS`
- `S-CSCF`
- `>5%`

1. **S-CSCF** `S-CSCF`

- `Web UI` `I-CSCF` `→` `S-CSCF`
- `S-CSCF`

2. `UAR/LIR`



3GPP

- **TS 23.228**  IMS  
- **TS 29.228**  Cx    I-CSCF  HSS 
- **TS 29.229**  Cx/Dx  

Diameter RFCs

- **RFC 6733**  Diameter    
- **RFC 7155**  Diameter NAT  



P-CSCF/E-CSCF



1. [IMS](#)
2. [IMS](#)
3. [P-CSCF](#)
4. [E-CSCF](#)
5. [Web UI](#)
6. [IMS](#)
7. [IMS](#)



P-CSCF IMS UE QoS P-CSCF **E-CSCF** CSCF

IMS P-CSCF UE **OmniTAS** P-CSCF SIP

3GPP

- **3GPP TS 23.228** IP IMS
- **3GPP TS 24.229** IMS
- **3GPP TS 33.203** IMS
- **3GPP TS 23.167** IP IMS



1. UE IMS SIP
2. IPsec
3. **QoS** Rx PCRF
4. IMEI MSISDN E-CSCF
5. SigComp
6. UDP TCP

IMS

3GPP

Gm	SIP/IPsec	UE	P-CSCF	
Mw	SIP	P-CSCF	I-CSCF/S-CSCF	IMS
Rx	Diameter	QoS/		PCRF
Ml	HTTP/HELD			LRF/E-CSCF
Mg	SIP			MGCF/E-CSCF

P-CSCF

1.

P-CSCF UE SIP REGISTER

Path: <sip:term@pcscf.ims.mnc001.mcc001.3gppnetwork.org:5060;lr>

- P-CSCF
- RFC 3327 IMS

- 599
- UE

IMEI

- Contact IMEI +sip.instance="<urn:gsma:imei:...>"
-

- iOS TCP


```

-----> OmniTAS
<----- RTP/SRTP  TAS
----->

```

P-CSCF SIP UE OmniTAS

4. QoS Rx

Diameter Rx

PCRF QoS

Diameter

P-CSCF Diameter 3868 PCRF Rx ID
16777236 3GPP ID 10415

Rx

1. AAR QoS
2. AAA PCRF /
3. STR QoS

AAR

PCRF

- IP
- /
-
-

5.

Pike pike

- 2 -
- 2 IP 16
- 300 5 - IP

P-CSCF

- IP
- 120
- IP 120 10 403 Too Many Failed Attempts IP
-

E-CSCF

P-CSCF E-CSCF

SIP URI

- urn:service:sos
- urn:service:sos.police
- urn:service:sos.ambulance
- urn:service:sos.fire
- urn:service:sos.marine
- urn:service:sos.mountain

URI

- INVITE
- URI
 - URN urn:service:sos* RFC 5031 SOS URN
 - 911
 - /112
-

IMEI MSISDN

911112urn:service:sosUE
SIP MSISDN PSAP - P-CSCF/E-CSCF IMEI MSISDN

1. MSISDN

- Contact +sip.instance IMEI
urn:gsma:imei:123456-78-901234-5
- From IMPU MSISDN
- IMEI → MSISDN 24 TTL86400
- imei_msisdn["urn:gsma:imei:123456789012345"] =
"12015551234"
- P-CSCF

2. MSISDN

- Contact +sip.instance IMEI
- IMEI MSISDN
- MSISDN

- P-Asserted-Identity sip:+12015551234@domain
- PSAP

-

P-CSCF IMEI→MSISDN

UE P-CSCF 1

1. IMEI→MSISDN
2. P-CSCF
3. P-CSCF 2 3
4. IMEI→MSISDN

UE P-CSCF 1 P-CSCF 2 IMEI→MSISDN PSAP

P-CSCF SIP

- SIP
- JSON IMEI→MSISDN TTL
- -
-

- P-CSCF
- P-CSCF UE
-
- Web UI P-CSCF → imei_msisdn

- P-CSCF
-
- P-CSCF SIP
-

1. `IMEI=123456789012345MSISDN=12015551234`
→ `imei_msisdn[123456789012345] = 12015551234`
2. `911INVITE urn:service:sosMSISDN From`
→ P-CSCF `Contact` `IMEI123456789012345`
→ P-CSCF `imei_msisdn[123456789012345]` → 12015551234
→ P-CSCF `P-Asserted-Identity: <sip:+12015551234@...>`
→ PSAP `+12015551234`

-
- `PIDF-LO`
- `PSAP`
-
- `LRF UE`

Web UI

P-CSCF

`https://<control-panel>/pcscf`

P-CSCF

1. `-`
2. `- IMSI/IP`
3. `-`

- **AoR** `SIP`
- **Contact** `URI`
- **Expires**
- **Public IP** `UE IP`
- **Received** `IP Contact`
- **Path**
- **Rx ID** `Diameter Rx QoS`

- 5
- AoR Contact
-
-

AoR: sip:12015551234@ims.mnc001.mcc001.3gppnetwork.org
 Contact: sip:12015551234@10.4.12.100:5060;transport=udp
 Expires: 2025-11-29 14:30:15
 Public IP: 10.4.12.100
 Received: 10.4.12.100:52341
 Path: <sip:term@pcscf.ims.mnc001.mcc001.3gppnetwork.org:5060;lr>
 Rx Session: rx-pcscf-session-12345

- IMSI imsi:310150123456789
- IP 10.4.12.100

1. IP
2. IMSI
3. IPsec
- 4.

imei_msisdn	IMEI→MSISDN	100-1000
service_routes		
dialog_out		

- " " "
-
- " "
- " " "

Key: urn:gsma:imei:123456-78-901234-5

Value: 310150123456789
TTL: 86400 24 24

24

MO

TAS OmniTAS

MT

TAS

24

24

24

UE

UE 408

24

1. 24
 - 24 P-CSCF
 - 24 "24"24
 - 24 24 24 24 24 24

2. 24 24 24 24 24 24 24 24 24 24 24 24 24 24 24 24 24 24

3. 24 UE P-CSCF 24 24 24 24 24

4. 24 24 24 24 24 24 24 24 24 SIP 24 24 24 24 5060 UDP/TCP

5. 24 P-CSCF 24 24 24 24 24 24 24 24 24 24 24 24 24 24

IPsec

24 24 24 24 401 24 24 24 24 24 24 24

24 24 24 24

1. 24 24 24 24 24 24 24 24 24 24 24 IPsec 24 24 24 24

2. UE REGISTER Security-Client
3. UE IPsec 5100 6100
4. IPsec
5. IPsec

UE

INVITE P-CSCF UE

1.
 - o P-CSCF
 - o “ ”
 - o
- 2.
- 3.
- 4.
5. P-CSCF UE

P-CSCF UE OmniTAS P-CSCF

1. INVITE/200 OK SDP IP
2. UE OmniTAS RTP/SRTP
3. UE NAT
4. OmniTAS UE

- 2 2 2 3 2 2 2
- 2 2 2 2

2 2 2 2 2

1. 2 2 2 2 2 2 2 2 2 2 2 2

- 2 2 2 P-CSCF → 2 2 2 2 2 2
- 2 2 2 2 2 2 2 2 2 2 2

2. 2 2 2 2 2 2 2 2 2 2 2 2

- 2 2 2 2 2 2 2 2 2 2
- 2 2 2 2 2 2 2 "2 2" 2 2 2 2 2 2 2 2 - 2 2 2 2 2 2

3. 2 P-CSCF 2 2

Diameter/Rx 2 2

PCRF 2 2 2 2 2

2 2 2 Web UI 2 Diameter 2 2 2 2 2 "2 2" 2 2

2 2 2 2 2

1. 2 2 2 2 2 2 2 2 Diameter 2 2 2 2 2 2

- 2 2 2 Diameter 2 2
- 2 2 P-CSCF 2 2
- 2 2 PCRF 2 2 2 2 2 2 2 2 2 2 "I_Open" 2

2. 2 2 2 PCRF 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2

3. 2 2 2 2 2 2 2 2 2 2 2 2 2 2

- 2 2 2 Diameter 2 2
- 2 2 PCRF 2 2 2
- 2 2 "2 2" 2 2

4. 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 Diameter 2 2 2 2

5. 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 Diameter 2 2

QoS 2 2 2 2 2 2

2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 QoS 2 2

2 2 2 2 2

1. AAR AAA
2. PCRF 2001
3. PCRF
4. SDP PCRF
5. QoS

1. IPsec LTE/5G
2. / TLS
3. Pike DoS
- 4.
5. TLS SSLv2/v3
6. IPsec

1. hash_size
 - 1,000 hash_size=10 $2^{10} = 1,024$
 - 10,000 hash_size=13 $2^{13} = 8,192$
 - 100,000 hash_size=16 $2^{16} = 65,536$
2. CPU
 - CPU SIP
 - tcp_children $2 \times$ CPU TCP
3. mlock_pages
 - mlock_pages=yes RAM
 -
4. IMS DNS
 - dns_cache_init=off DNS
 - DNS SRV
5. SRV
 - dns_srv_lb=yes
 - DNS SRV

RFCs

- **RFC 3261**◇ SIP
- **RFC 3327**◇◇◇◇
- **RFC 3608**◇◇◇◇◇◇
- **RFC 3GPP-IMS**◇P-◇◇P-Asserted-Identity ◇◇
- **RFC 5626**◇◇◇◇◇◇◇◇◇◇



S-CSCF



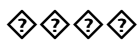
1. [IMS](#)
2. [IMS](#)
3. [S-CSCF](#)
4. [Web UI](#)
5. [IMS](#)
6. [IMS](#)



S-CSCF IMS S-CSCF

3GPP

- 3GPP TS 23.228 IP IMS
- 3GPP TS 24.229 IMS
- 3GPP TS 29.228 Cx S-CSCF HSS
- 3GPP TS 29.229 Cx Dx
- 3GPP TS 23.218 ISC S-CSCF AS
- 3GPP TS 32.260 IMS



1. SIP
2. HSS
- 3.
4. iFC
5. HSS
6. SUBSCRIBE/PUBLISH/NOTIFY
7. PSTN / PSTN

S-CSCF Ro OCS TAS 2G/3G S-CSCF



-

- **IMS** **HSS** **ISC** **IMS** **CSCF**

IMS

3GPP

Mw	SIP	I-CSCF/P-CSCF	S-CSCF	I-CSCF, P-CSCF
ISC	SIP	S-CSCF	AS, TAS	
Cx	Diameter	HSS		
Ro	Diameter	OCS		
Rf	Diameter	CDR	CDF/CGF	
Mi	SIP	S-CSCF	BGCF	PSTN

S-CSCF

1.

S-CSCF

S-CSCF

- 599
- 1024
- IMPU IMPI

- **AKAv1-MD5** 3GPP AKA MD5 LTE/5G
- **AKAv2-MD5** AKA
- **MD5** HTTP
- **CableLabs-Digest** PacketCable/IMS
- **3GPP-Digest** Digest-MD5
- **TISPAN-HTTP_DIGEST_MD5** ETSI TISPAN
- **HSS-Selected** HSS

AKA

1. **RAND** 128
2. **AUTN** HSS
3. **XRES** UE
4. **CK/IK** IPsec /

```
nonce = base64(RAND) + ":" + algorithm_indicator
```

```
UE_response = base64(RES)
Expected = base64(XRES)
```

```
if (UE_response == Expected) {
    #
} else {
    #
}
```

AKA

UE SQN HSS

1. UE AUTS
2. S-CSCF AUTS
3. S-CSCF HSS AUTS MAR
4. HSS
5. S-CSCF

S-CSCF

- / / 599 10
- / / 599

- IMPU 1
-

2. USRLOC

S-CSCF

S-CSCF

IMPU IP SIP URI IMPU

- sip:user@domain.com
-
-
- /
- CCF1, CCF2, ECF1, ECF2

IMPU IMPU

- URI
-
- P-CSCF
-
- REGISTER IP

IMPIs IMPUs

HSS XML iFC

S-CSCF 20,000+ ~50,000 8,192

Web UI

/scscf Web

-
- IMPU
- IFC IFC

Web

3. iFC

S-CSCF iFC

iFC ❖❖❖XML❖

❖❖ HSS ❖❖❖❖❖❖❖❖❖❖

```
<IMSSubscription>
  <PrivateID>user@ims.mnc001.mcc001.3gppnetwork.org</PrivateID>
  <ServiceProfile>
    <PublicIdentity>
      <Identity>sip:user@ims.mnc001.mcc001.3gppnetwork.org</Identity>
      <IdentityType>0</IdentityType>  <!-- 0=❖❖❖❖❖❖ -->
    </PublicIdentity>

    <InitialFilterCriteria>
      <Priority>0</Priority>  <!-- ❖❖❖❖❖❖❖❖ -->
      <TriggerPoint>
        <ConditionTypeCNF>1</ConditionTypeCNF>  <!-- 0=DNF, 1=CNF -->
        <SPT>
          <ConditionNegated>0</ConditionNegated>
          <Group>0</Group>
          <Method>INVITE</Method>
        </SPT>
        <SPT>
          <ConditionNegated>0</ConditionNegated>
          <Group>0</Group>
          <SessionCase>0</SessionCase>  <!-- 0=❖❖ -->
        </SPT>
      </TriggerPoint>
      <ApplicationServer>

<ServerName>sip:tas.ims.mnc001.mcc001.3gppnetwork.org</ServerName>
      <DefaultHandling>0</DefaultHandling>  <!--
0=SESSION_CONTINUE, 1=SESSION_TERMINATED -->
    </ApplicationServer>
  </InitialFilterCriteria>

  <InitialFilterCriteria>
    <Priority>1</Priority>
    <TriggerPoint>
      <ConditionTypeCNF>0</ConditionTypeCNF>  <!-- DNF -->
      <SPT>
        <ConditionNegated>0</ConditionNegated>
        <Group>0</Group>
        <RequestURI>^sip:\+1800.*</RequestURI>  <!-- ❖❖❖❖ -->
      </SPT>
    </TriggerPoint>
    <ApplicationServer>
      <ServerName>sip:tollfree-as.example.com</ServerName>
      <DefaultHandling>0</DefaultHandling>
```

```

        </ApplicationServer>
    </InitialFilterCriteria>
</ServiceProfile>
</IMSSubscription>

```

◆◆◆◆◆◆◆◆SPT◆

SPT ◆◆◆

1. ◆◆◆SIP ◆◆◆INVITE◆MESSAGE◆SUBSCRIBE ◆◆
2. **RequestURI**◆◆ Request-URI ◆◆◆◆◆◆
3. **SIPHeader**◆◆◆ SIP ◆◆◆◆/◆
4. **SessionCase**◆◆◆◆0◆◆◆◆◆1◆◆◆◆◆◆◆◆2◆
5. **SessionDescription**◆SDP ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆

◆◆◆

- **CNF**◆◆◆◆◆◆◆AND ◆ OR - (A OR B) AND (C OR D)
- **DNF**◆◆◆◆◆◆◆OR ◆ AND - (A AND B) OR (C AND D)

◆◆◆◆◆◆◆◆◆ SPT ◆ OR ◆◆◆◆◆◆◆◆◆ AND ◆◆◆◆◆ CNF◆◆

iFC ◆◆◆◆

◆◆ **Web UI** ◆◆ **iFC**

◆◆◆◆◆◆ Web ◆◆◆◆◆◆◆◆◆◆

1. ◆◆ **iFC**◆◆◆◆◆◆◆◆ iFC - ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆ XML ◆◆
2. ◆◆ **iFC**◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆ AS - ◆◆◆◆◆◆◆ IMPU◆◆◆◆ URI ◆◆◆◆ URI ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆ iFC ◆◆◆◆

Web UI ◆◆◆◆◆

1. ◆◆◆ S-CSCF ◆◆
2. ◆◆ "IFC" ◆◆◆
3. ◆◆ IMPU
4. ◆◆ "Dump IFC" ◆ "Test IFC"
5. ◆◆◆◆◆ iFC ◆◆◆◆◆◆◆◆◆ AS ◆◆

4. ◆◆◆◆

S-CSCF ◆◆◆◆◆◆◆◆◆◆◆ SIP ◆◆◆◆◆◆

□□□□□

S-CSCF □□□□□□□□□□□□□□□□□□□□□□□□

- Call-ID□SIP □□□□□□□□□□
- From/To URI □□□
- □□□□□□□□□□CSeq□
- □□□□□□□
- □□□□□
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- □□□□□□□□□□□□□□180 □□□
- □□□□□□ 200 OK □□□/□□ ACK□□□□□□□
- □□□□□□□/□□ BYE□□□□□□□

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Web UI □□□

1. □□□ S-CSCF → □□□□□
2. □□□□□□□□□□□
 - Call-ID
 - From/To URI
 - □□□□□□/□□□
 - □□□□□
 - □□
3. □□ "□□□□□" □□□□□□□□□
4. □□ "□□□□□□□□□□" □□□□□□□□□□

5. □□□□□□□

□□□□□□□□□□□□□□S-CSCF □□□□□□□□□□

9. SUBSCRIBE/PUBLISH

S-CSCF          SIP     

◆ ◆ ◆ ◆ ◆ ◆





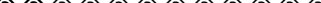
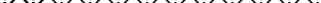



S-CSCF 

- 3600 1 -
- " " -
- **PIDF** - PIDF

PUBLISH

◆◆◆◆◆ S-CSCF ◆◆◆ PUBLISH ◆◆◆◆◆

1.  PUBLISH 
2.  403 
3.  PUBLISH 
4.  500 


SUBSCRIBE

S-CSCF SUBSCRIBE

1. SUBSCRIBE
2.
 - "reg"
 - SAR HSS
 - iFC ""
3. SUBSCRIBE
4. 500

Web UI

◇◇ S-CSCF ◇◇

?? ?? https://<?? ??>/scscf

S-CSCF

1. 12015551234 - 12015551234
2. 12015551234 - 12015551234 IMPU 12015551234
3. 12015551234 - 12015551234
4. IFC - 12015551234 12015551234
5. 12015551234 - 12015551234

12015551234

12015551234 12015551234

12015551234

- IMPU 12015551234 SIP URI 12015551234
- 12015551234 12015551234
- 12015551234 12015551234/12015551234
- 12015551234 12015551234

12015551234

- 12015551234 50 12015551234
- 12015551234 IMPU 12015551234
- 12015551234
- 12015551234 12015551234 12015551234 12015551234

12015551234

IMPU: sip:12015551234@ims.mnc001.mcc001.3gppnetwork.org

12015551234: 1

12015551234: 12015551234

12015551234: 2025-11-29 15:45:30

[12015551234:]

12015551234: sip:12015551234@10.4.12.100:5060;transport=tcp

12015551234: <sip:term@pcscf.ims.mnc001.mcc001.3gppnetwork.org:5060;lr>

12015551234: Android IMS 12015551234 v1.0

12015551234: 10.4.12.100:52341

12015551234

- 12015551234 IMPU
- 12015551234 IFC 12015551234 12015551234
- 12015551234 IFC 12015551234 AS 12015551234
- 12015551234 12015551234 12015551234 12015551234

12015551234

12015551234 IMPU 12015551234

???

1. ?? IMPU?????sip:user@domain.com?
2. ?? "??"
3. ??????
 - o ??????
 - o ?????
 - o ?????
 - o ???
 - o ??? IMPIs?????

???

- ??????
- ??????
- ?????
- ?????

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- **Call-ID**?SIP Call-ID
- **From URI**?????
- **To URI**????
- ??????
- ??????
- ??????

???

- ?????? 5 ?????
- ?????? BYE?
- ??????

???

Call-ID: 3c26700857a87f84@10.4.12.165
From: sip:12015551234@ims.mnc001.mcc001.3gppnetwork.org
To: sip:+12015555678@ims.mnc001.mcc001.3gppnetwork.org
?: ?
?: 2025-11-29 15:30:15
?: 360000 ?

[????] ??

????????????????????????????????

IFC

IFC HSS IFC IFC

IFC

1. IMPU
2. "IFC"
3. iFC
 -
 - SPT
 - URI
 -

```
<InitialFilterCriteria>
  <Priority>0</Priority>
  <TriggerPoint>
    <ConditionTypeCNF>1</ConditionTypeCNF>
    <SPT>
      <Group>0</Group>
      <Method>INVITE</Method>
    </SPT>
    <SPT>
      <Group>0</Group>
      <SessionCase>0</SessionCase> <!-- -->
    </SPT>
  </TriggerPoint>
  <ApplicationServer>

<ServerName>sip:tas.ims.mnc001.mcc001.3gppnetwork.org</ServerName>
  <DefaultHandling>0</DefaultHandling>
</ApplicationServer>
</InitialFilterCriteria>
```

IFC

1. IMPU
2. URI
3. URI
4. "IFC"
5. iFC
 -

- ? ? ? ? ? ? ? ?

? ? ?

- ? ? ? ? ? ? ? ?
- ? ? ? ? ? ? ? AS ? ? ? ?
- ? ? ? ? ? ? ? ? ? ? ? ? iFC
- ? ? ? ? ? ? ? ? ? ? ? ?

? ? ? ? ? ?

? P-CSCF ? I-CSCF ? ? ? ? ? ? ? ? ? ? ? ? ? ?

? ? ? **S-CSCF** ? ? ? ?

- auth ? ? ? ? ? ? ?
- profile ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
- ? ? ? ? ? ? ? ? ? ?

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? ? ? ? ? ? ? ? ? ? ? ? ? ? "1. ? ? ? ? ? ?" ? ? ?

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? ? ? ? ? ? ? ? ? ? ? ? ? ? "5. ? ? ? ? ? ? ?" ? ? ?

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? ? ? ? ? ? ? ? ? ? ? ? ? ? "6. ? ? ? ? ? ? ?" ? ? ?

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? ? ? ? ? ? - **403** ? ?

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- ? ? ? ? HSS ? ? ?
- HSS ? ? ? ?
- ? ? ? ?
- ? ? ? ?

3. S-CSCF

4.

iFC AS

1. iFC

- S-CSCF → IFC
- IMPU
- "IFC"
- URI

2. Web iFC

- S-CSCF → IFC
- IMPU URI URI
- "IFC"
- iFC

3. HSS

4. HSS SAA XML

5. S-CSCF iFC

BYE

1.

- S-CSCF →
-

2. BYE

3.

4.

- S-CSCF →
-
- " "

5.

CCR

S-CSCF TAS
S-CSCF Ro

- OCS
- Ro
-

1. OCS

-
- S-CSCF
- OCS "I_Open"

2. S-CSCF OCS

3.

4. S-CSCF CCR/CCA

-

S-CSCF

402

1. S-CSCF

2. OCS

3. S-CSCF CCA

4. S-CSCF TAS

PSTN

PSTN - 503

- MGCF/
-
-

1. PSTN
2. S-CSCF SIP
- 3.
- 4.

CPU

-
-
- iFC

1.
 - S-CSCF →
 -
2. impu impu_contact
3. impu.impu dialog.callid
4. 4 8



3GPP

- **TS 23.228**  IMS  
- **TS 24.229**  IMS SIP  
- **TS 29.228**  Cx  
- **TS 23.218**  ISC  
- **TS 32.260**  IMS  



Web UI



1. [!\[\]\(de424d4359ba1f2bd1c4df4a39123e9b_img.jpg\)!\[\]\(1603d6802560f9588644d7f89a9520bb_img.jpg\)](#)
2. [!\[\]\(7d992463829b40d86ca5ff48af771a6e_img.jpg\)!\[\]\(7d02a23afcc0a5ccea127782dc34e2c8_img.jpg\)!\[\]\(78473e213372e8313e0a9124f0a91f11_img.jpg\)!\[\]\(2572e00034713d126c72d9a47f4a4fcb_img.jpg\)!\[\]\(f53939e0a6ec14964b75f7db03f8909b_img.jpg\)!\[\]\(9ac27cb9127ea5b08e8437c746fb2354_img.jpg\)!\[\]\(543128e3c0a269d8aa42bd445ad7779c_img.jpg\)](#)
3. [P-CSCF !\[\]\(dca65dd6b7ff51c7f04785b91b526682_img.jpg\)!\[\]\(e1a1cc1492d8deea6c2c85629220dc6a_img.jpg\)](#)
4. [I-CSCF !\[\]\(602f3fb44413db78390091791dbcd003_img.jpg\)!\[\]\(d31dbaa81b3869734d3702c26faa0c7d_img.jpg\)](#)
5. [S-CSCF !\[\]\(315e1d74088192bd49c48beed26c2ca4_img.jpg\)!\[\]\(de036ca1f04a17c37d8df481f5d16d61_img.jpg\)](#)
6. [Diameter !\[\]\(caf61f0f9bdf13e90575fa369a484384_img.jpg\)!\[\]\(459bd14dde0d2e29acf3773dc2982517_img.jpg\)!\[\]\(dea8e7ee3a487567f8e62faa4fd72ede_img.jpg\)!\[\]\(606ca8a13afd0d2bcd9de72437bbf5e4_img.jpg\)!\[\]\(ad6d0fa86397ef98b2cca0923918d1c6_img.jpg\)!\[\]\(f6325e52f777c03384dad13fa0cd935b_img.jpg\)](#)
7. [!\[\]\(ed7da813abb12e7f7ff537800a88c3f7_img.jpg\)!\[\]\(dbd9794ff20bee1250202bd517e07b32_img.jpg\)!\[\]\(e24705f8a8f5162203506d9cd33e8808_img.jpg\)!\[\]\(537f6cfe0a58c263d143fe4207452e5c_img.jpg\)!\[\]\(65f64a5e188e18f8eaa0823894a9b6c8_img.jpg\)](#)
8. [!\[\]\(f6312b405ac772c1ad07a0e3e3fe4c2c_img.jpg\)!\[\]\(159bf32b7b81fa697f2fc1c9628bcf87_img.jpg\)!\[\]\(2b67c312f0124fa1f29f53eb0bbf80b9_img.jpg\)!\[\]\(f88625052d579881dfc6ed936243fb54_img.jpg\)](#)
9. [!\[\]\(9ce530e79ae7047922ee2a901eeedf64_img.jpg\)!\[\]\(544fbdf727b83925879cce2bbaa5c395_img.jpg\)!\[\]\(e1cb2cea16373cd588e6d36f9bd0b302_img.jpg\)!\[\]\(fe019ab07c18bdc7ca1468b6305593c5_img.jpg\)!\[\]\(a9739c19d8ac92d050351b27aaa497e5_img.jpg\)!\[\]\(6a7def505f327a17a3b0e956e772ee06_img.jpg\)](#)



OmniCall CSCF Web UI  CSCF  P-CSCF  I-CSCF  S-CSCF  Phoenix LiveView 

- 
- 
- **Diameter** 
- **Prometheus** 
- 



 CSCF 

- 
- 
-  Diameter 
- 
- 



 HTTP  CSCF 

http://<cscf-server>:4000/

4000 ControlPanel.Supervisor

config/config.exe config/runtime.exe CSCF

```
config :cscf, :cscf_hosts,  
  pcscf: [  
    {host: "10.4.12.165", port: 9060, label: "P-CSCF 1"}  
  ],  
  icscf: [  
    {host: "10.4.12.166", port: 9060, label: "I-CSCF 1"}  
  ],  
  scscf: [  
    {host: "10.4.12.167", port: 9060, label: "S-CSCF 1"}  
  ]
```

CSCF

- **P-CSCF** - /pcscf -
- **I-CSCF** - /icscf - S-CSCF NDS
- **S-CSCF** - /scscf - IFC
- **Diameter** - /diameter - Diameter
- - /logs -

P-CSCF

URL/pcscf

P-CSCF P-CSCF

IMS P-CSCF

IMSI IMSI
 SIP Path

???

?? I-CSCF ? ? ? ? ? ? ? ? ? ? ??? ?

S-CSCF ??

URL?/scscf

S-CSCF ? IFC ? ? ?

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- ?? IMPU ? ? ? ? ? ?
 - ? ? ? ? ? ? ? IMPU ?
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 - ? ? ? ?
 - ?
 - Call-ID

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- ? ? ? ? ? ? ? ? IMPU ? ?
- ?? **IFC** ? ? ? ? ? ? ? ? ? ? ? ? ? ?
- ?? **IFC** ? ? ? ? ? ? ? ? ? IFC ? ?
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- ? ? ? ? S-CSCF ? ? ? ? ? ? ? ? ? ?
- **IMPU** ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
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?? ID h_entry:h_id ? ? ?
Call-ID SIP Call-ID
?? ? ? ? ? URI

- $\diamond \diamond$ URI $\diamond \diamond \diamond \diamond \diamond$

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- $\diamond \diamond \diamond \diamond$
- $\diamond \diamond \diamond$ IFC $\diamond \diamond$
- $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$ IFC $\diamond \diamond$








 S-CSCF

Diameter

URL /diameter



◆◆◆◆◆ Diameter ◆◆◆◆◆ Cx◆ Rx◆ Ro ◆◆◆◆◆

◆ ◆ ◆ ◆








-  Diameter 
-  Diameter Origin-Host
- 
-  CDP 
- 
- 
- 
- 







?? Diameter ? ? ? ? ? ? ?

[illegible]






 I Open
 
 Closed
 





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◆◆◆◆◆ Diameter ◆◆◆◆◆

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2. ? ? ? ? ?
3. ? ? ? ? ? ? ? ? ? ? ? ? ? ?
4. ? ? ? ? ?

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3. ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
4. ? ? ? ? ?

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- imei_msisdn ?
- auth ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
- service_routes ? ? ? ? ? ? ? ? ? ? ? ? I-CSCF ? ? ? ?

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URL ? /logs

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ControlPanel

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-
-

Prometheus

OmniCall CSCF Prometheus

http://<host>:9090/metrics

CSCF P-CSCF I-CSCF S-CSCF 9090 Prometheus

P-CSCF I-CSCF S-CSCF [9090](#)

OmniCall CSCF CSCF SIP Diameter IMS [9090](#)

VM

- vm_memory_total - Erlang VM
- vm_memory_processes_used -
- vm_memory_binary -
- vm_memory_ets - ETS
- vm_total_run_queue_lengths_total -
- vm_system_counts_process_count -
- vm_system_counts_atom_count -
- vm_system_counts_port_count -

Phoenix HTTP

- phoenix_endpoint_stop_duration - HTTP
- phoenix_router_dispatch_stop_duration -

LiveView

- phoenix_live_view_mount_stop_duration - LiveView

CSCF

- cscf_backend_request_count - RPC
 - host command result
- cscf_backend_request_duration - RPC
 - host command
- cscf_backend_error_count - RPC
 - host error_type

Grafana

Prometheus Grafana

- RPC
-
-
-
- Erlang VM
- LiveView

Prometheus CSCF

```
scrape_configs:
- job_name: 'cscf_pcscf'
  static_configs:
    - targets: ['pcscf1.example.com:9090',
'pcscf2.example.com:9090']

- job_name: 'cscf_icscf'
  static_configs:
    - targets: ['icscf1.example.com:9090',
'icscf2.example.com:9090']

- job_name: 'cscf_scscf'
  static_configs:
    - targets: ['scscf1.example.com:9090',
'scscf2.example.com:9090']
```

???

???

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- Prometheus
- RPC
- Erlang VM

???

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-

???

-
- Diameter
- CSCF

??

- 5
-
-

???

- [P-CSCF](#) - P-CSCF
- [I-CSCF](#) - I-CSCF
- [S-CSCF](#) - S-CSCF
- [Diameter](#) - Diameter
- [CSCF](#) - CSCF



ANSSI R226

R226-3 R226-7 OmniCSCF IMS ANSSI R226

ANSSI

R226 -

1.

1.1

OmniCSCF IMS
IP IMS
VoIP/VoLTE

- P-CSCF
- E-CSCF
- I-CSCF
- S-CSCF

IP IMS

1.2

1.2.1

SIP

CSCF SIP

- - IMPU IP - SIP URI
sip:+33612345678@ims.mnc001.mcc001.3gppnetwork.org

- IMPI IP 123456789 - 123456789
user@ims.mnc001.mcc001.3gppnetwork.org
- IMSI 123456789 - 12 P 12 HSS
- MSISDN 123456789 - 12 IMPU 12 HSS 123456789

- 123456

- 12 URI 123 UE 12345
- 1234567 P-CSCF 123456
- 123456789 S-CSCF 1
- 123456789123456789123456789
- 123456789
- 12 IP 123456
- 123456789 TCP/UDP/TLS 1
- 123456789 RAND 123456789 XRES 123456789 IK 12 HSS 1

- 123456789

- P-Access-Network-Info 123456789123456
- P-Visited-Network-ID 123456789123456
- 123 IP 123456789123456
- P-CSCF 123456789123456

123456789

S-CSCF 123456789123456 SIP 123456789

- 123456789

- Call-ID 123456789123456
- From/To URI 1234
- 123456789
- Original-Dialog-ID 123456789123456789123456789

- 123456789

- 123456789 From 12 P-Asserted-Identity 1
- 123456789 To 123456789 URI 1
- 123456789123456
- 123456789123456
- 123456789123456/123456/123456789
- CSeq 123456789123456

- 123456789

- SIP 123456789 SDP 123456789123456
- 123456789123456789 OmniTAS 1
- 123456789123456789/123456789
- 123456789

- 







- IMEI_{15} 112911
- IMEI MSISDN
- UE
- HELD HTTP
- PSAP/ AS

◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆














- IPsec  SPI 
- UE 
- IPsec  
- 

[illegible]

-  Call-ID  From/To 
- 
-  /  / 
- 

◆ CDR ◆◆◆◆◆

CSCF

- CDRs
-
-
-

CDR - TAS - OmniTAS CSCF

SIP/Diameter

CSCF

- SIP SIP INVITE REGISTER
- Diameter Diameter Cx Rx Ro
-

1.2.3

Phoenix LiveView

- -
 - IMPU IMPI
 -
 -
- -
 - Call-ID From/To URI
 - BYE
 - 5
- - Diameter HSS PCRF OCS
 -
 -
 - IPsec P-CSCF

- 
- SIP  HSS  AKA 
- Diameter 

◆ ◆ ◆ ◆ ◆

- SIP Diameter
- /
-
- Web UI
-
- /

1.3.2

◆ ◆ ◆ ◆ ◆

- $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \text{RBAC} \diamond$
- $\diamond \diamond \diamond \diamond \diamond \diamond \diamond$
- $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$







-  5060 SIP  3868 Diameter  8086 Web UI 
- SIP 
- Max-Forwards 
- 
- 
- 

1.4

1.5.1 ETSI

CSCF  ETSI  X1/X2/X3 
 LIMF

◆◆ ETSI LI ◆◆◆

X1   -      

- 
-  LEMF $\rightarrow$ LIMF 
- 
 -  IMPU  IMSI  MSISDN  / 
 - 
 - 
 - 

- **CSCF**
 - LIMF - CSCF
 - LIMF CSCF
 - LIMF X1

X2 - IRI

-
- LIMF → LEMF
- ETSI TS 102 232 XML/ASN.1
- **CSCF**
 - Call-ID
 - From URI P-Asserted-Identity IMPU IMSI MSISDN
 - To URI URI IMPU IMSI MSISDN
 -
 - /
 - P-Access-Network-Info
 - P-CSCF/S-CSCF
 -
 - P-Visited-Network-ID

X3 - CC

-
- LIMF → LEMF
- ETSI TS 102 232
- **CSCF**
 - SIP SDP
 - RTP
 -
 - SIP MESSAGE
 - CSCF

/ RTP LIMF OmniTAS
CSCF SDP

1.5.2 CSCF

1.

P-CSCF

- IMPU
- URI UE
- IP
-
-
- IPsec SPI

INFO: INVITE sip:+33687654321@ims.mnc001.mcc001.3gppnetwork.org SIP/
2.0
From: <sip:+33612345678@ims.mnc001.mcc001.3gppnetwork.org>;tag=abc123
To: <sip:+33687654321@ims.mnc001.mcc001.3gppnetwork.org>
Call-ID:
f81d4fae-7dec-11d0-a765-00a0c91e6bf6@ims.mnc001.mcc001.3gppnetwork.org
P-Asserted-Identity:
<sip:+33612345678@ims.mnc001.mcc001.3gppnetwork.org>
P-Access-Network-Info: 3GPP-E-UTRAN-FDD; utran-cell-
id-3gpp=208011234567890
Content-Type: application/sdp

```
v=0
o=- 1234567890 1234567890 IN IP4 192.168.1.100
s=-
c=IN IP4 10.20.30.40
t=0 0
m=audio 49170 RTP/AVP 0 8
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
```

- [illegible]

- IMSI 
- MSISDN 
-  IMPUs 
- 

```
Diameter Cx SAA received from HSS:
User-Name: user@ims.mnc001.mcc001.3gppnetwork.org
Public-Identity: sip:+33612345678@ims.mnc001.mcc001.3gppnetwork.org
Server-Name: sip:scscf.ims.mnc001.mcc001.3gppnetwork.org
Result-Code: 2001 (Success)
User-Data: <XML user profile with IMSI, MSISDN, iFC>
```

5. E-CSCF

IMEI $\diamond$ MSISDN $\diamond \diamond \diamond$

- P-CSCF ? UE ?? IMEI ??????
- 24 ?? TTL????
- ??????
- ? P-CSCF ???????







- [illegible]









-  112  911 
-  P  IMEI
-  HELD  P-Access-Network-Info 
- PSAP 
- E-CSCF  AS 

1.5.3 LIMF



1.

- 
- 
- 

2. $\diamondsuit \diamondsuit \diamondsuit \diamondsuit \diamondsuit \diamondsuit \diamondsuit$

- SIP
- HSS Diameter
-

3. $\diamond \diamond \diamond \diamond \diamond$

- 
- 
- 































 LIMF
 



1.5.4 CSCF LI

CSCF    **IRI**  **X2**    

CSCF IRI

IMPU SIP / Party
A sip:33612345678@ims.mnc001.mcc001.3gppnetwork.org

IMPI SIP / ID
user@ims.mnc001.mcc001.3gppnetwork.org

IMSI HSS ID
208011234567890

MSISDN HSS
+33612345678

Call-ID SIP / ID
f81d4fae-7dec-11d0-a765-00a0c91e6bf6@...

From/To SIP
A/
Party B sip:33612345678@... / sip:33687654321@...

2025-11-29T10:30:00Z

P-Access-
Network-
Info SIP 3GPP-E-UTRAN-FDD;utran-cell-
id-3gpp=208011234567890

IP SIP UE IP
10.20.30.40:5060

P-CSCF SIP
10.4.12.165:5060

S-CSCF SIP
10.4.11.45:5060

CSCF CC X3

CSCF CC

SIP MESSAGE " "

INVITE SDP RTP
RTP 10.50.60.70:49170

RTP LIMF OmniTAS RTP
CSCF

1.5 Web

Web

-
-
- IMPU IMPI IMSI MSISDN

- ◆ ◆ ◆ ◆

2.

OmniCSCF ANSSI

???

- 

- **AES-CBC** $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$ - $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$
 - AES-128-CBC $\diamond 128 \diamond \diamond \diamond \diamond$
 - AES-192-CBC $\diamond 192 \diamond \diamond \diamond \diamond$
 - AES-256-CBC $\diamond 256 \diamond \diamond \diamond \diamond \diamond$ - $\diamond \diamond$
- **AES-GCM** $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$ - **Galois**/ $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$
 - AES-128-GCM $\diamond 128 \diamond \diamond \diamond \diamond \diamond \diamond$ AEAD $\diamond$
 - AES-256-GCM $\diamond 256 \diamond \diamond \diamond \diamond \diamond \diamond$ AEAD $\diamond$ - $\diamond \diamond$
- **3DES-CBC** $\diamond \diamond \diamond$ **DES** - $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$
 - 168 $\diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond \diamond$
- **NULL** $\diamond \diamond \diamond$

- 128 128 128 128 128 128 128 128
- 128 128 128 128 128 128 128 128 128 128 128 128 128 128 128 128

128 128 128 128 128 128 128 128

• **HMAC-SHA1** 128 128 128 128 128 128 128 128 - **SHA-1** 128

- 160 128 128
- 128 128 128 128

• **HMAC-SHA256** 128 **HMAC - SHA-256** 128

- 256 128 128
- 128

• **HMAC-SHA384** 128 **HMAC - SHA-384** 128

- 384 128 128

• **HMAC-SHA512** 128 **HMAC - SHA-512** 128

- 512 128 128

• **HMAC-MD5** 128

- 128 128 128
- 128 128 128 128 128 128 128 128 128 128 128 128 128 128 128 128

128 128 128 128 128 128 128 128

IPsec 128 128 128 CK - 128 128 128 128 IK - 128 128 128 128 128 128 128 128 IMS AKA 128 128 128 128 128 128 128 128

1. UE 128 S-CSCF/HSS 128 AKA 128
2. HSS 128 CK 128 128 128 IK 128 128 128
3. S-CSCF 128 128 128 128 128 128 CK/IK 128 128 P-CSCF
4. P-CSCF 128 CK/IK 128 UE 128 IPsec 128 128 128 128
5. CK 128 ESP 128
6. IK 128 ESP 128

128 128 128 128 128 128 128 128

- 128 128 128 128 128 SIP 128 128 128 128 128 128 128 128 599 128
- 128 128 128 128 128 128 128 128 128 128 128 128 128 128 128 128
- 128 128 128 128 32 128 64 128 ESN - 128 128 128 128 128
- 128 128 128 128 128 128 128 128 128 128 128 128 128 AKA 128 128 128 128 Diffie-Hellman 128

128 128 128

P-CSCF IPsec 128 128 128

- Linux IPsec XFRM
- API
- SPI
-

2.2.2 IPsec

P-CSCF

- ESP AES-256-GCM HMAC-SHA256
- ESP AES-256-CBC HMAC-SHA256

- ESP AES-128-CBC HMAC-SHA1
- ESP 3DES-CBC HMAC-SHA1

- IKE
- IMS AKA CK/IK HSS
- XFRM
- SA

1. UE → AKA → CK/IK
2. P-CSCF S-CSCF CK/IK
3. P-CSCF SPI SPI SPI
4. P-CSCF
5. P-CSCF CK/IK IPsec SA
6. P-CSCF 200 OK IPsec UE Security-Server
7. UE IPsec SA
8. SIP ESP
9. SA

2.3 TLS SIP Diameter

2.3.1 SIP TLS SIPS

TLS

- TLS 1.2 RFC 5246 -
- TLS 1.3 RFC 8446 -

- **TLS 1.0/1.1** - 1111111111
- **SSL 2.0/3.0** - 1111111111

TLS 111

111111 OpenSSL 1 LibreSSL1

- 111111 TLS 1
- 1111111111111111
- 1111111111

1111111111

TLS 1.311111111

- TLS_AES_256_GCM_SHA384
- TLS_AES_128_GCM_SHA256
- TLS_CHACHA20_POLY1305_SHA256

TLS 1.2111111

- ECDHE-RSA-AES256-GCM-SHA3841111111111
- ECDHE-RSA-AES128-GCM-SHA2561111111111
- ECDHE-ECDSA-AES256-GCM-SHA3841111111111
- DHE-RSA-AES256-GCM-SHA3841111111111
- DHE-RSA-AES128-GCM-SHA2561111111111

11111111

- 1 RC4
- 1 MD5
- 1 NULL 11
- 1 EXPORT 111
- 1 DES/3DES111111

1111111

- **X.509** 1111111111
- **RSA** 111 11 2048 11111 4096 1
- **ECDSA** 111 11 P-2561P-3841P-521 11
- 1111111
- **CRL**1111111111111111
- **OCSP**11111111111111111111

TLS 111

- 11111111**PFS**11 11 ECDHE/DHE 1111
- 11111111**SNI**11 11
- **TLS** 111111 111111111111

- 3GPP TS 33.045 TLS

SIP over TLS/SIPS

- 3GPP TS 33.045 TLS/TCP
- 3GPP TS 5061 SIPS
- 3GPP TS 23.238 CSCF
- 3GPP TS 23.238

2.3.2 Diameter/TLS

Diameter

3GPP TS 33.045

- Diameter over SCTP
- Diameter over TCP with TLS
- 3GPP TS 3868 Diameter

3GPP

- Cx S-CSCF/I-CSCF HSS
- Rx P-CSCF PCRF/QoS
- Ro S-CSCF OCS -

Diameter/TLS

SIP

- TLS 1.2/1.3
- ECDHE/DHE PFS
- AES-GCM
- SHA256/SHA384

3GPP TS 33.045

- Diameter/TLS
- TLS
- FQDN
- CA

2.4

2.4.1 IMS AKA

3GPP AKA/MILENAGE

RAND/AUTN/XRES/CK/IK

□□□□□

- **f1**□ □□□□□□□□□□ MAC-A □ MAC-S□
- **f2**□ □□□□□□□□ RAND □ K □□ RES□
- **f3**□ □□□□□□□□□□ CK□
- **f4**□ □□□□□□□□□□ IK□
- **f5**□ □□□□□□□□□□ AK □□□ IMSI □□□

□□□□□

- **K**□ 128 □□□□□□□□□□ ISIM □ HSS □□
- **OPc**□ □□□□□□□□□□ K □ OP □□□
- **RAND**□ 128 □□□□□□
- **SQN**□ 48 □□□□□□□□□□

AKA □□□

1. HSS □□ RAND□□□□□□□□□□
2. HSS □□ MAC-A = f1(K, RAND, SQN, AMF)
3. HSS □□ AUTN = (SQN ⊕ AK) || AMF || MAC-A
4. HSS □□ XRES = f2(K, RAND)
5. HSS □□ CK = f3(K, RAND)
6. HSS □□ IK = f4(K, RAND)
7. HSS □ {RAND, AUTN, XRES, CK, IK} □□□ S-CSCF
8. S-CSCF □ RAND □ AUTN □□ UE
9. UE □□ ISIM □□ RES = f2(K, RAND)
10. UE □ RES □□□ S-CSCF
11. S-CSCF □ RES □ XRES □□□□□□□□□□

□□□□□

- □□□□□ UE □□ AUTN □□ HSS□HSS □□ RES □□ UE
- □□□□□□ RAND □□□□□□ SQN □□□□
- □□□□□ CK □ IK □□□□□ K □□

2.4.2 HTTP □□□□

□□□ IMS □□□□□□□□□□

□□□ MD5□RFC 2617□

- □□□□□ MD5□128 □□□□
- □□-□□□ □□□□□
- □□□□□ □□□□□□□□□

□□□ HTTP □□□ MD5 □□□□□□□□□□□□□□ IMS AKA□

2.5

2.5.1

OpenSSL/

- **SHA-256** 256
- **SHA-384** 384
- **SHA-512** 512
- **SHA-1** 160
- **MD5** 128

- IPsec/TLS HMAC
-
-
- ID

2.5.2

SIP

- **IPsec ESP** HMAC-SHA256 SIP over IPsec
- **TLS** TLS MAC
- **SIP**

Diameter

- **TLS** Diameter over TLS
- **HMAC** Diameter HMAC AVP

2.6

- **Linux** /dev/urandom PRNG
- **OpenSSL RAND_bytes()**: CSPRNG

- SPI
- ID
-
-
- ID

2.7

2.7.1 TLS







- `0600`
- `/etc/system/tls/`
- `PEM`


```
# openssl genrsa -out system-key.pem 4096

# openssl req -new -key system-key.pem -out system.csr \
    -subj "/C=FR/ST=IDF/L=Paris/O=0mnitouch/
    CN=scscf.ims.mnc001.mcc001.3gppnetwork.org"

# openssl x509 -req -days 365 -in system.csr \
    -signkey system-key.pem -out system-cert.pem

# openssl ca -in system.csr -out system-cert.pem -key CA-key.pem -cert CA-cert.pem
```


- 
- 
- 

2.7.2 IPsec

◆ ◆ ◆ ◆ ◆

- CK IK IMS AKA
- 128      HSS
-   Diameter Cx          TLS 

- SIP 599
-
-

◆ ◆ ◆ ◆ ◆

- [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- [RFC 4303](#) IPsec [RFC 4304](#)
- [RFC 4303](#) [RFC 4304](#) [RFC 4305](#)
- [RFC 4303](#) SA [RFC 4304](#) [RFC 4305](#)

2.8 [RFC 4303](#) [RFC 4304](#) [RFC 4305](#)

2.8.1 [RFC 4303](#) [RFC 4304](#)

[RFC 4303](#) [RFC 4304](#) [RFC 4305](#)

- [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) [RFC 4311](#) [RFC 4312](#) [RFC 4313](#) [RFC 4314](#) [RFC 4315](#) [RFC 4316](#) [RFC 4317](#) [RFC 4318](#) [RFC 4319](#) [RFC 4320](#)
- [RFC 4303](#) [RFC 4304](#) AES-256 [RFC 4305](#) RSA-4096 [RFC 4306](#) SHA-256
- [RFC 4303](#) [RFC 4304](#) AES-GCM [RFC 4305](#) AEAD - [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) [RFC 4311](#) [RFC 4312](#) [RFC 4313](#) [RFC 4314](#) [RFC 4315](#) [RFC 4316](#) [RFC 4317](#) [RFC 4318](#) [RFC 4319](#) [RFC 4320](#)
- [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) TLS [RFC 4306](#) ECDHE/DHE
- [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) OpenSSL/LibreSSL [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)

[RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)

- MD5 [RFC 4303](#) [RFC 4304](#) [RFC 4305](#)
- RC4 [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- DES/3DES [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) [RFC 4311](#) [RFC 4312](#) [RFC 4313](#) [RFC 4314](#) [RFC 4315](#) [RFC 4316](#) [RFC 4317](#) [RFC 4318](#) [RFC 4319](#) [RFC 4320](#)
- SSL 2.0/3.0 [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- TLS 1.0/1.1 [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) BEAST [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) POODLE [RFC 4303](#) [RFC 4304](#) [RFC 4305](#)

2.8.2 [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)

[RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)

- [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) OpenSSL [RFC 4303](#) [RFC 4304](#) [RFC 4305](#)

[RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)

- [RFC 4303](#) IPsec [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) [RFC 4311](#) [RFC 4312](#) [RFC 4313](#) [RFC 4314](#) [RFC 4315](#) [RFC 4316](#) [RFC 4317](#) [RFC 4318](#) [RFC 4319](#) [RFC 4320](#)

2.9 [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)

[RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)

- **NIST SP 800-52** [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) TLS [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- **NIST SP 800-131A** [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- **RFC 7525** [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) TLS [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- **ETSI TS 133 203** [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) 3GPP [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) IMS AKA [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- **ETSI TS 133 210** [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) IP [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) IPsec [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)
- **3GPP TS 33.203** [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#) IMS [RFC 4303](#) [RFC 4304](#) [RFC 4305](#) [RFC 4306](#) [RFC 4307](#) [RFC 4308](#) [RFC 4309](#) [RFC 4310](#)

- **3GPP TS 33.210**     

-               
-             
- ANSSI           



IMS CSCF

P-CSCF I-CSCF S-CSCF



CSCF 9090 Prometheus

http://<host>:9090/metrics

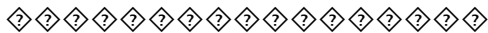
CSCF P-CSCF I-CSCF S-CSCF Prometheus

Prometheus

```
scrape_configs:
- job_name: 'cscf_pcscf'
  static_configs:
    - targets: ['pcscf1.example.com:9090',
'pcscf2.example.com:9090']

- job_name: 'cscf_icscf'
  static_configs:
    - targets: ['icscf1.example.com:9090']

- job_name: 'cscf_scscf'
  static_configs:
    - targets: ['scscf1.example.com:9090',
'scscf2.example.com:9090']
```



- [Web UI](#)
- [Diameter](#)



OmniCall CSCF Prometheus Diameter

S-CSCF

UI ims_usrloc_scscf_active_impus
ims_usrloc_scscf_active_contacts

Diameter

Diameter

cdp_queuelength "I_Open"

Diameter

- **16777216:10415 (Cx/Dx)** - I-CSCF S-CSCF HSS UAR
LIRMAR SAR
- **16777236:10415 (Rx)** - P-CSCF PCRF QoS
- **4 (Ro)** - S-CSCF

ims_icscf_uar_*ims_icscf_lir_*ims_auth_mar_*
ims_registrar_scscf_sar_*ims_qos_*

P-CSCF

CDP (Diameter)

cdp_average_response_time	Diameter replies_response_time / replies_received
cdp_queuelength	Diameter
cdp_replies_received	Diameter
cdp_replies_response_time	Diameter
cdp_timeout	Diameter

SIP

core_rcv_requests	SIP
core_rcv_requests_ack	ACK
core_rcv_requests_bye	BYE
core_rcv_requests_cancel	CANCEL

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core_rcv_replies_2xx_message ◇ MESSAGE ◇◇◇ 2xx◇◇◇◇◇◇◇◇
 core_rcv_replies_2xx_prack ◇ PRACK ◇◇◇ 2xx◇◇◇◇◇◇◇◇
 core_rcv_replies_2xx_refer ◇ REFER ◇◇◇ 2xx◇◇◇◇◇◇◇◇
 core_rcv_replies_2xx_reg ◇ REGISTER ◇◇◇ 2xx◇◇◇◇◇◇◇◇
 core_rcv_replies_2xx_update ◇ UPDATE ◇◇◇ 2xx◇◇◇◇◇◇◇◇

◇◇◇◇◇◇◇◇◇◇3xx◇

◇◇◇◇

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core_rcv_replies_3xx_bye ◇ BYE ◇◇◇ 3xx◇◇◇◇◇◇◇◇
 core_rcv_replies_3xx_cancel ◇ CANCEL ◇◇◇ 3xx◇◇◇◇◇◇◇◇
 core_rcv_replies_3xx_invite ◇ INVITE ◇◇◇ 3xx◇◇◇◇◇◇◇◇
 core_rcv_replies_3xx_message ◇ MESSAGE ◇◇◇ 3xx◇◇◇◇◇◇◇◇
 core_rcv_replies_3xx_prack ◇ PRACK ◇◇◇ 3xx◇◇◇◇◇◇◇◇
 core_rcv_replies_3xx_refer ◇ REFER ◇◇◇ 3xx◇◇◇◇◇◇◇◇
 core_rcv_replies_3xx_reg ◇ REGISTER ◇◇◇ 3xx◇◇◇◇◇◇◇◇
 core_rcv_replies_3xx_update ◇ UPDATE ◇◇◇ 3xx◇◇◇◇◇◇◇◇

◇◇◇◇◇◇◇◇◇◇4xx◇

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◇◇

core_rcv_replies_4xx_bye ◇ BYE ◇◇◇ 4xx◇◇◇◇◇◇◇◇
 core_rcv_replies_4xx_cancel ◇ CANCEL ◇◇◇ 4xx◇◇◇◇◇◇◇◇
 core_rcv_replies_4xx_invite ◇ INVITE ◇◇◇ 4xx◇◇◇◇◇◇◇◇
 core_rcv_replies_4xx_message ◇ MESSAGE ◇◇◇ 4xx◇◇◇◇◇◇◇◇
 core_rcv_replies_4xx_prack ◇ PRACK ◇◇◇ 4xx◇◇◇◇◇◇◇◇
 core_rcv_replies_4xx_refer ◇ REFER ◇◇◇ 4xx◇◇◇◇◇◇◇◇
 core_rcv_replies_4xx_reg ◇ REGISTER ◇◇◇ 4xx◇◇◇◇◇◇◇◇
 core_rcv_replies_4xx_update ◇ UPDATE ◇◇◇ 4xx◇◇◇◇◇◇◇◇

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core_rcv_replies_5xx_bye ◇ BYE ◇◇◇ 5xx◇◇◇◇◇◇◇◇
 core_rcv_replies_5xx_cancel ◇ CANCEL ◇◇◇ 5xx◇◇◇◇◇◇◇◇
 core_rcv_replies_5xx_invite ◇ INVITE ◇◇◇ 5xx◇◇◇◇◇◇◇◇
 core_rcv_replies_5xx_message ◇ MESSAGE ◇◇◇ 5xx◇◇◇◇◇◇◇◇
 core_rcv_replies_5xx_prack ◇ PRACK ◇◇◇ 5xx◇◇◇◇◇◇◇◇
 core_rcv_replies_5xx_refer ◇ REFER ◇◇◇ 5xx◇◇◇◇◇◇◇◇
 core_rcv_replies_5xx_reg ◇ REGISTER ◇◇◇ 5xx◇◇◇◇◇◇◇◇
 core_rcv_replies_5xx_update ◇ UPDATE ◇◇◇ 5xx◇◇◇◇◇◇◇◇

6xx

core_rcv_replies_6xx_bye	◇ BYE ◇◇◇ 6xx◇◇◇◇◇◇◇◇◇◇
core_rcv_replies_6xx_cancel	◇ CANCEL ◇◇◇ 6xx◇◇◇◇◇◇◇◇◇◇
core_rcv_replies_6xx_invite	◇ INVITE ◇◇◇ 6xx◇◇◇◇◇◇◇◇◇◇
core_rcv_replies_6xx_message	◇ MESSAGE ◇◇◇ 6xx◇◇◇◇◇◇◇◇◇◇
core_rcv_replies_6xx_prack	◇ PRACK ◇◇◇ 6xx◇◇◇◇◇◇◇◇◇◇
core_rcv_replies_6xx_refer	◇ REFER ◇◇◇ 6xx◇◇◇◇◇◇◇◇◇◇
core_rcv_replies_6xx_reg	◇ REGISTER ◇◇◇ 6xx◇◇◇◇◇◇◇◇◇◇
core_rcv_replies_6xx_update	◇ UPDATE ◇◇◇ 6xx◇◇◇◇◇◇◇◇◇◇

core_rcv_replies_400	◇◇◇◇ 400 Bad Request ◇◇◇◇
core_rcv_replies_401	◇◇◇◇ 401 Unauthorized ◇◇◇◇
core_rcv_replies_402	◇◇◇◇ 402 Payment Required ◇◇◇◇
core_rcv_replies_403	◇◇◇◇ 403 Forbidden ◇◇◇◇
core_rcv_replies_404	◇◇◇◇ 404 Not Found ◇◇◇◇
core_rcv_replies_405	◇◇◇◇ 405 Method Not Allowed ◇◇◇◇
core_rcv_replies_406	◇◇◇◇ 406 Not Acceptable ◇◇◇◇
core_rcv_replies_407	◇◇◇◇ 407 Proxy Authentication Required ◇◇◇◇
core_rcv_replies_408	◇◇◇◇ 408 Request Timeout ◇◇◇◇
core_rcv_replies_409	◇◇◇◇ 409 Conflict ◇◇◇◇
core_rcv_replies_410	◇◇◇◇ 410 Gone ◇◇◇◇
core_rcv_replies_411	◇◇◇◇ 411 Length Required ◇◇◇◇
core_rcv_replies_413	◇◇◇◇ 413 Request Entity Too Large ◇◇◇◇
core_rcv_replies_414	◇◇◇◇ 414 Request-URI Too Long ◇◇◇◇
core_rcv_replies_415	◇◇◇◇ 415 Unsupported Media Type ◇◇◇◇
core_rcv_replies_420	◇◇◇◇ 420 Bad Extension ◇◇◇◇
core_rcv_replies_480	◇◇◇◇ 480 Temporarily Unavailable ◇◇◇◇
core_rcv_replies_481	◇◇◇◇ 481 Call/Transaction Does Not Exist ◇◇◇◇
core_rcv_replies_482	◇◇◇◇ 482 Loop Detected ◇◇◇◇
core_rcv_replies_483	◇◇◇◇ 483 Too Many Hops ◇◇◇◇
core_rcv_replies_484	◇◇◇◇ 484 Address Incomplete ◇◇◇◇
core_rcv_replies_485	◇◇◇◇ 485 Ambiguous ◇◇◇◇
core_rcv_replies_486	◇◇◇◇ 486 Busy Here ◇◇◇◇
core_rcv_replies_487	◇◇◇◇ 487 Request Terminated ◇◇◇◇
core_rcv_replies_488	◇◇◇◇ 488 Not Acceptable Here ◇◇◇◇
core_rcv_replies_489	◇◇◇◇ 489 Bad Event ◇◇◇◇
core_rcv_replies_491	◇◇◇◇ 491 Request Pending ◇◇◇◇
core_rcv_replies_493	◇◇◇◇ 493 Undecipherable ◇◇◇◇

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◆◆◆◆
core_fwd_replies ◆◆◆ SIP ◆◆◆◆
core_fwd_requests ◆◆◆ SIP ◆◆◆◆
core_drop_replies ◆◆◆ SIP ◆◆◆◆
core_drop_requests ◆◆◆ SIP ◆◆◆◆
core_err_replies ◆◆◆◆◆◆◆◆
core_err_requests ◆◆◆◆◆◆◆◆
core_bad_URIIs_rcvd ◆◆◆◆◆◆◆◆◆◆◆◆ URI ◆◆◆◆◆◆
core_bad_msg_hdr ◆◆◆◆◆/◆◆◆◆◆◆◆◆◆◆◆◆
core_unsupported_methods ◆◆◆◆◆◆◆ SIP ◆◆◆◆◆◆◆◆

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◆◆◆◆◆ ◆◆◆
dialog_ng_active ◆◆◆◆◆◆◆◆◆/◆◆◆◆◆◆◆◆◆◆
dialog_ng_early ◆◆◆◆◆◆◆◆◆/◆◆◆◆◆◆◆◆◆◆
dialog_ng_expired ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
dialog_ng_processed ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆

DNS ◆◆

◆◆◆◆◆ ◆◆◆
dns_failed_dns_request ◆◆◆ DNS ◆◆◆◆◆
dns_slow_dns_request ◆◆ DNS ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆

IMS IPsec P-CSCF

◆◆◆◆◆ ◆◆◆
ims_ipsec_pcscf_spi_free ◆◆◆◆◆◆◆◆◆ SPI ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
ims_ipsec_pcscf_spi_total ◆◆◆◆◆◆◆ SPI ◆◆◆
ims_ipsec_pcscf_spi_used ◆◆◆◆◆◆◆/◆◆◆◆ SPI ◆◆◆◆
ims_ipsec_pcscf_spi_utilization_pct SPI ◆◆◆◆◆◆◆◆◆◆◆◆
ims_ipsec_pcscf_worker_cache_size ◆◆◆◆◆ IPsec ◆◆◆◆◆◆◆◆

IMS QoS (Rx ◆◆)

◆◆ AAR ◆◆

◆◆◆◆◆ ◆◆◆
ims_qos_active_registration_rx_sessions ◆◆◆◆◆◆◆◆ Rx ◆◆◆◆◆◆
ims_qos_registration_aars ◆◆◆◆◆◆ AAR ◆◆◆◆◆-◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
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Pike

pike_blocked_ips IP

registrar_accepted_regs REGISTER
registrar_rejected_regs REGISTER
registrar_default_expire
registrar_default_expires_range
registrar_expires_range
registrar_max_contacts AOR
registrar_max_expires

script_register_failed
script_register_success
script_register_time

SCTP

sctp_assoc_shutdown SCTP
sctp_comm_lost SCTP
sctp_connect_failed SCTP
sctp_current_opened_connections SCTP
sctp_current_tracked_connections SCTP
sctp_established SCTP
sctp_local_reject SCTP
sctp_remote_shutdown SCTP
sctp_send_failed SCTP
sctp_send_force_retry SCTP
sctp_sendq_full

shmem_fragments
shmem_free_size
shmem_max_used_size

shmem_real_used_size
 shmem_total_size
 shmem_used_size

SL

sl_1xx_replies 1xx
 sl_2xx_replies 2xx
 sl_3xx_replies 3xx
 sl_4xx_replies 4xx
 sl_5xx_replies 5xx
 sl_6xx_replies 6xx
 sl_xxx_replies

sl_200_replies 200 OK
 sl_202_replies 202 Accepted
 sl_300_replies 300 Multiple Choices
 sl_301_replies 301 Moved Permanently
 sl_302_replies 302 Moved Temporarily
 sl_400_replies 400 Bad Request
 sl_401_replies 401 Unauthorized
 sl_403_replies 403 Forbidden
 sl_404_replies 404 Not Found
 sl_407_replies 407 Proxy Authentication Required
 sl_408_replies 408 Request Timeout
 sl_483_replies 483 Too Many Hops
 sl_500_replies 500 Server Internal Error

sl_sent_replies
 sl_sent_err_replies
 sl_received_ACKs ACK
 sl_failures

TCP

	???		??
tcp_con_reset		TCP	????????????????? RST?
tcp_con_timeout	?????	TCP	????
tcp_connect_failed	????	TCP	?????
tcp_connect_success	????	TCP	????
tcp_current_opened_connections	????	TCP	????
tcp_current_write_queue_size	????	TCP	?????????????
tcp_established	???	TCP	?????????????
tcp_local_reject	?????	TCP	????
tcp_passive_open	????	TCP	????
tcp_send_timeout	???	TCP	?????????????
tcp_sendq_full	?????		?????????????

TM/TMX

```

? ? ? ? ? ?
tmx_UAC_transactions  ? ? ? UAC ? ? ? ? ? ? ? ?
tmx_UAS_transactions  ? ? ? UAS ? ? ? ? ? ? ? ? ? ?
tmx_active_transactions ? ? ? ? ? ? ? ?
tmx_inuse_transactions ? ? ? ? ? ? ? ? ? ?

```

```

? ? ? ? ? ? ? ?
      ? ? ? ?      ? ?
tmx_2xx_transactions ? 2xx ? ? ? ? ? ? ? ? ? ?
tmx_3xx_transactions ? 3xx ? ? ? ? ? ? ? ? ? ?
tmx_4xx_transactions ? 4xx ? ? ? ? ? ? ? ? ? ?
tmx_5xx_transactions ? 5xx ? ? ? ? ? ? ? ? ? ?
tmx_6xx_transactions ? 6xx ? ? ? ? ? ? ? ? ? ?

```

```

? ? ? ? ? ?
      ? ? ? ?           ? ?
tmx_rpl_absorbed    ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
tmx_rpl_generated   ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
tmx_rpl_received    ? ? ? ? ? ? ? ? ? ? ? ?
tmx_rpl_relayed     ? ? ? ? ? ? ? ? ? ? ? ? ?
tmx_rpl_sent        ? ? ? ? ? ? ? ? ? ? ? ? ?

```

USRLOC

usrloc_location_contacts'location' usrloc
usrloc_location_expires 'location'
usrloc_registered_users /AOR

I-CSCF

I-CSCF P-CSCF SIP P-CSCF SIP
I-CSCF

I-CSCF

I-CSCF S-CSCF

I-CSCF HSS S-CSCF
UAR LIR

IMS I-CSCF (Cx - HSS)

I-CSCF Diameter Cx HSS

UAR

ims_icscf_uar_avg_response_time UAR
uar_replies_response_time /
uar_replies_received
ims_icscf_uar_replies_received HSS UAA
ims_icscf_uar_replies_response_time UAR
ims_icscf_uar_timeouts UAR

LIR

ims_icscf_lir_avg_response_time LIR
lir_replies_response_time /
lir_replies_received
ims_icscf_lir_replies_received HSS LIA
ims_icscf_lir_replies_response_time LIR
ims_icscf_lir_timeouts LIR

???

I-CSCF ? P-CSCF ?

- **CDP (Diameter)** ? - Diameter ?
- **SIP** ? - ?/?
- **DNS** ? - DNS ?
- **MySQL** ? - ?
- **Pike** ? - IP ?
- ? - ?
- **SL** ? - ?
- **TCP** ? - TCP ?
- **TM/TMX** ? - ?

S-CSCF ?

S-CSCF ? P-CSCF ? I-CSCF ? SIP ? P-CSCF ? SIP ?
S-CSCF ?

S-CSCF ?

S-CSCF ? IFC ?

IMPUs ? IMPUs ?
ims_usrloc_scscf_active_contacts ? ims_usrloc_scscf_active_impus ?

IFC ? SIP ? IFC ? IFC ?
tmx_* ?

IMS ?Cx ? - MAR?

S-CSCF ? Diameter Cx ? MAR ? HSS ?

???

??

ims_auth_mar_avg_response_time

MAR ?
mar_replies_response_time /
mar_replies_received?

ims_auth_mar_replies_received

? HSS ? MAA ?

ims_auth_mar_replies_response_time ? MAR ?

ims_auth_mar_timeouts

MAR ?

IMS S-CSCF

ims_registrar_scscf_accepted_reg	REGISTER
ims_registrar_scscf_rejected_reg	REGISTER
ims_registrar_scscf_default_expire	
ims_registrar_scscf_default_expires_range	
ims_registrar_scscf_max_contacts	
ims_registrar_scscf_max_expires	
ims_registrar_scscf_notifies_in_q	NOTIFY

SAR

ims_registrar_scscf_sar_avg_response_time	SAR sar_replies_response_time / sar_replies_received
ims_registrar_scscf_sar_replies_received	HSS SAA
ims_registrar_scscf_sar_replies_response_time	SAR
ims_registrar_scscf_sar_timeouts	SAR

IMS USRLOC S-CSCF

ims_usrloc_scscf_active_contacts	
ims_usrloc_scscf_active_impus	IMPUsIMS
ims_usrloc_scscf_active_subscriptions	
ims_usrloc_scscf_contact_collisions	
ims_usrloc_scscf_imp_u_collisions	IMPU
ims_usrloc_scscf_subscription_collisions	

S-CSCF

dialog_ng_active	/
dialog_ng_early	/

dialog_ng_expired
dialog_ng_processed

S-CSCF P-CSCF

- **CDP (Diameter)** - Diameter
- **SIP** - /S-CSCF
fwd_requests fwd_replies
- **DNS** - DNS
- **MySQL** -
- **Pike** - IP
- -
- **SL** -
- **TCP** - TCP
- **TM/TMX** - S-CSCF UAC UAS