

vCSCF Network Impact Report from 1.6.x to 1.11.0

Call Session Control Function

NETWORK IMPACT REPORT

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1 Introduction

This Network Impact Report (NIR) describes how the Virtual Call Session Control Function (vCSCF) 1.11.0 with new and enhanced commercial features affects the vCSCF 1.6.x. The NIR also describes the impact on the overall network, including all affected products and functions.

In this document, the term “vCSCF” refers to the product and the term “CSCF” refers to the CSCF application, independent of being deployed in a native or virtual environment.

Note: The vCSCF product is a software-only product. It is not bundled with any hardware platform or virtualization software.

This document covers the following enhanced features:

- 3rd Party Registration

- Authentication

Note: The enhancements in this feature are valid for all authentication features in the CSCF.

- Emergency Call Handling

- Graceful Shutdown

- Implicit Registration

- Load Regulation

- OAM Management (Virtualized)

- Offline Charging

- P-CSCF Restoration

- SIP Request Handling

- Traceability and Troubleshooting

- Transit Support

- User Initiated Registration/Deregistration

- VNF-LCM Workflows

- VNF Robustness

- VNF Scaling





2 General Impact

This section describes the general impact because of the introduction of the vCSCF 1.11.0.

2.1 Backward Compatibility

The vCSCF is backward compatible, except for synchronizing Number Normalization configuration.

The configuration of Number Normalization is changed. The same function level exists, but the method for synchronizing the configuration is changed. See Number Normalization Configuration Synchronization in Section 5.7 OAM Management (Virtualized) on page 37.

2.2 Capacity and Performance

The subscriber capacity decreases slightly by the introduction of the vCSCF 1.11.0 if the same version of cloud environment is used.

The network performance is not affected by the introduction of the vCSCF 1.11.0.

2.3 Hardware and Platform

The vCSCF is a software-only product.

The demands on the hardware and platform are specified in Virtual CSCF Infrastructure Requirements.

2.4 Upgrade Impact

Smooth upgrade is supported for the vCSCF 1.6.x – vCSCF 1.11.0 upgrade.

The upgrade from vCSCF 1.6.x to vCSCF 1.11.0 can only be done using the ONE_STEP upgrade method. This method requires a cluster reboot and causes traffic loss during the upgrade procedure, see vCSCF Upgrade Information from 1.6.x to 1.11.0

2.5 Deprecated Features

There are no deprecated features.



2.6 Obsolete Features

Signalling Manager tool is no longer used as a configuration tool for Signalling System No.7 (SS7) Common Application Feature (CAF).

2.7 Other Network Elements

The Northbound Interface (NBI) is modified, which may affect external management systems, for example the Operation and Support System Radio and Core (OSS-RC).



3 Interfaces

This section describes interface changes between the existing and new revisions of the product. The changes to interfaces described here can require changes to the operator systems, technical plans, training of operator personnel, and so on.

No impact indicates that no changes are needed.

3.1 Inter-Node Interface

The changes to the inter-node interfaces are listed in Table 1.

The description of impact is as follows:

- **No Impact** means that the new version can be installed without affecting other nodes.
- **Minor Impact** means that there are changes, but with extra configuration the previous behavior can be kept.
- **Major Impact** implies that the change has made an interface backward incompatible.
- **New Interface** indicates that the interface did not exist in the previous revision.
- **Obsolete** means that the interface no longer exists.

Table 1 Inter-node Interfaces

Interface	Protocol	Impact	Description of Change Compared To vCSCF 1.6.x
Gm and Mw	SIP	No Impact	The Public User Identities can be sorted in different orders. The sorting depends on the configuration of parameter <code>scscfPAssociatedUriBehavior</code> in the S-CSCF, see also Table 4.
ISC	SIP	No Impact	Redistribution of application server traffic in CSCF is enhanced by configuration of the parameter <code>scscfReregAsEntry</code> .

3.2 Operation and Maintenance

This section describes changes to attributes, alarms, SNMP alerts, and counters.



3.2.1 Provisioning and Configuration

This section lists changed, deleted, and new attributes.

Further information on attributes can be found in the following documents:

- Managed Object Model (MOM)
- CSCF Configuration Management

3.2.1.1 Changed Attributes

The changed attributes are described in Table 2.

Table 2 Changed Attributes

Attribute Name	Description In vCSCF 1.6.x	Description In vCSCF 1.11.0
Graceful Shutdown		
scscfRegisteredUsersThreshold	<p>scscfRegisteredUserThreshold is set to 0, the CSCF automatically enters the administrative state Locked when the threshold is reached. For non-zero values, the CSCF automatically enters the administrative state Unlocked when the threshold is reached. This attribute is not access aware.</p> <p>Default value: 0</p>	<p>If scscfRegisteredUserThreshold is set to 0, the CSCF automatically enters the administrative state LOCKED when the threshold is reached. For non-zero values, the CSCF automatically enters the administrative state UNLOCKED when the threshold is reached. This attribute is not access-aware.</p> <p>This attribute must not be set with a value larger than 0 when scscfShuttingdownBehavior is FORCED_TO_LOCKED.</p> <p>Default value: 0</p>
Load Regulation		
cscfSipOverloadControlReactingTrafficPriorities	<p>This attribute is used to map the outgoing SIP requests to SIP overload control reacting internal priority levels. 16 priority levels are supported, where value 0 is the highest one. This attribute is only applicable when cscfSipOverloadControlReactingEnabled is true. This attribute is not access-aware.</p> <p>This attribute can be configured as a string, where the priority is provided first and then a list of SIP request groups. The possible groups are Emergency, RphWps0, RphWps1, RphWps2, RphWps3, RphWps4, Inside, and Default.</p> <p>Default value is 0:RphWps0, RphWps1;1:RphWps2, RphWps3;2:RphWps4;3:Emergency;6:Inside;15:Default.</p>	<p>This attribute is used to map the outgoing SIP requests to SIP overload control reacting internal priority levels. 16 priority levels are supported, where value 1 is the highest priority and 15 is the lowest. All SIP requests with priority 0 are never redirected or rejected. This attribute is only applicable when cscfSipOverloadControlReactingEnabled is true. This attribute is not access-aware.</p> <p>This attribute can be configured as a string, where the priority is provided first and then a list of SIP request groups. The possible groups are Emergency, RphWps0, RphWps1, RphWps2, RphWps3, RphWps4, Inside, and Default.</p> <p>Default value is 0:Inside, RphWps0, RphWps1;1:RphWps2, RphWps3;2:RphWps4;3:Emergency;15:Default.</p>



Table 2 Changed Attributes

Attribute Name	Description In vCSCF 1.6.x	Description In vCSCF 1.11.0
cscfSipOverloadControlReportingFairnessBehavior	<p>This attribute controls if the CSCF rejects a volume of incoming traffic from a node that does not support SIP overload control. The volume of incoming traffic is corresponding to the percentage level of how much traffic that a node supporting SIP overload control reduces traffic towards the CSCF node.</p> <p>This attribute is only applicable when <code>cscfSipOverloadControlReportingEnabled</code> is set to true. This attribute is not access-aware.</p> <p>Default value is Sip503Response.</p>	<p>This attribute controls if the CSCF rejects a volume of incoming traffic from a node that does not support SIP overload control. The volume of incoming traffic is corresponding to the percentage level of how much traffic that a node supporting SIP overload control reduces traffic towards the CSCF node.</p> <p>This attribute is only applicable when <code>cscfSipOverloadControlReportingEnabled</code> is set to true. This attribute is not access-aware.</p> <p>Default value is NoFairness.</p>
cscfSipOverloadOnset	<p>This attribute is used to configure the average cluster resource utilization level that must be exceeded to activate the SIP overload control reporting function. This attribute is only applicable when <code>cscfSipOverloadControlReportingEnabled</code> is set to true. This attribute is not access-aware.</p> <p>This attribute can be configured with a value between 0–100.</p> <p>Default value is 75.</p>	<p>This attribute is used to configure the average cluster resource utilization level that must be exceeded to activate the SIP overload control reporting function. This attribute is only applicable when <code>cscfSipOverloadControlReportingEnabled</code> is set to true. This attribute is not access-aware.</p> <p>This attribute can be configured with a value between 0–100.</p> <p>Default value is 85.</p>
OAM Management (Virtualized)		
cscfAdministrativeState	<p>This attribute indicates the current administrative state of the CSCF. This attribute is used to set the node state to 0 (Locked), 1 (Unlocked), or 2 (Shutting down).</p> <p>A short description of the behavior of CSCF at different states of <code>cscfAdministrativeState</code> is given here.</p> <p>When the node is in state: 0 (Locked), the CSCF is to be taken out of service as soon as possible. Established sessions, except emergency sessions, are released, users are deregistered, and new SIP requests are rejected.</p> <p>When the node is in state: 1 (Unlocked), the CSCF node handles requests and performs functions normally.</p> <p>When the node is in state: 2 (Shutting down), the CSCF is gracefully taken out of service with minimal traffic disturbance. As long as users are registered, non-register traffic is processed as when in UnLocked state. Users are de-registered/re-distributed when handling registration traffic. When all users are de-registered/re-distributed and all sessions are terminated, the CSCF automatically transits from Shutting down to Locked state.</p> <p>The default value is 0 (Locked).</p>	<p>This attribute indicates the current administrative state of the CSCF. This attribute is used to set the node state to 0 (Locked), 1 (Unlocked), or 2 (Shutting down).</p> <p>A short description of the behavior of the CSCF at different states of <code>cscfAdministrativeState</code> is given here.</p> <p>When the node is in state: 0 (Locked), the CSCF is to be taken out of service as soon as possible. <code>cscfAdministrativeState</code> is not allowed to change from Locked to Unlocked when <code>cscfLockedbehavior</code> is FORCED and still in active state. It is also not allowed to change <code>cscfAdministrativeState</code> from Locked to Shutting down.</p> <p>When the node is in state: 1 (Unlocked), the CSCF node handles requests and performs functions normally.</p> <p>When the node is in state: 2 (Shutting down), the CSCF is gracefully taken out of service with minimal traffic disturbance and the CSCF automatically transits from Shutting down to Locked or Unlocked, depending on the configuration.</p> <p>The default value is 0 (Locked).</p>
SIP Request Handling		



Table 2 Changed Attributes

Attribute Name	Description In vCSF 1.6.x	Description In vCSF 1.11.0
cscfBlacklistingBypassThrottle	<p>This parameter controls what percentage of initial SIP requests is to be sent to destinations that have been blacklisted as unreachable for other reasons than transaction time-out. It is possible to define the percentage of requests that should be sent in this case.</p> <p>If <code>CscfBlacklistingBypassThrottle</code> has the value 0, it means that CSCF behaves as recommended in standards, that is, send a 500 error if all destinations are blacklisted. How long a destination is blacklisted depends on the reason why it was blacklisted.</p> <p>If <code>CscfBlacklistingBypassThrottle</code> has the value 100, it means that no matter what the reason is, and for how long the node is blacklisted, the CSCF tries to send initial SIP requests towards it in 100% of the cases (that is, ignore the blacklisting completely).</p> <p>If <code>CscfBlacklistingBypassThrottle</code> has another value, for example 70, it means that 70% of all requests disregards the blacklisting and the initial SIP requests are sent anyway.</p>	<p>This parameter controls what percentage of initial SIP requests is to be sent to destinations that have been blacklisted as unreachable because of a SIP 503 with <code>Retry-After</code>. It is possible to define the percentage of requests that should be sent in this case.</p> <p>As long as at least one destination transport address is not blacklisted, that address is used and this parameter has no effect.</p> <p>If <code>cscfBlacklistingBypassThrottle</code> has the value 0, it means that CSCF does not overrule blacklisting for destinations blacklisted because of SIP 503 with <code>Retry-After</code>. The unreachable destination transport address is blacklisted for a configurable period of time (<code>cscfDestinationUnavailabilityTimer</code>).</p> <p>If blacklisting reason is SIP 503 with <code>Retry-After</code> and <code>cscfBlacklistingBypassThrottle</code> has the value 100, it means that no matter for how long the node is blacklisted, the CSCF tries to send initial SIP requests towards it in 100% of the cases: that is, ignore the blacklisting completely.</p> <p>If <code>cscfBlacklistingBypassThrottle</code> has another value, for example 70, it means that 70% of all requests disregards the blacklisting and the initial SIP requests are sent anyway.</p>
cscfBlacklistingInsideDialogRequestBypassThrottle	<p>This parameter controls how much of inside dialogue SIP requests should be sent to destinations that have been blacklisted as unreachable. It is possible to define the percentage of inside dialogue SIP requests that should be sent in this case.</p> <p>If <code>cscfBlacklistingInsideDialogRequestBypassThrottle</code> has the value 0, it means that CSCF behaves as recommended in standards, that is, send a 500 error if all destinations are blacklisted. How long a destination is blacklisted depends on the reason why it was blacklisted.</p> <p>If <code>cscfBlacklistingInsideDialogRequestBypassThrottle</code> has the value 100, it means that no matter what the reason is, and for how long the node is blacklisted, the CSCF tries to send inside dialogue SIP requests towards it in 100% of the cases (that is, ignore the blacklisting completely).</p> <p>If <code>cscfBlacklistingInsideDialogRequestBypassThrottle</code> has another value, for example 70, it means that 70% of all requests disregard the blacklisting and the requests are sent anyway.</p>	<p>This parameter controls how much of inside dialogue SIP requests should be sent to destinations that have been blacklisted as unreachable. It is possible to define the percentage of inside dialogue SIP requests that should be sent in this case. As long as at least one destination transport address is not blacklisted, that address is used and this parameter has no effect.</p> <p>If <code>cscfBlacklistingInsideDialogRequestBypassThrottle</code> has the value 0, it means that CSCF does not overrule blacklisting for any inside dialogue SIP request. How long a destination is blacklisted depends on the reason why it was blacklisted.</p> <p>If <code>cscfBlacklistingInsideDialogRequestBypassThrottle</code> has the value 100, it means that no matter what the reason is, and for how long the node is blacklisted, the CSCF tries to send inside dialogue SIP requests towards it in 100% of the cases (that is, ignore the blacklisting completely).</p> <p>If <code>cscfBlacklistingInsideDialogRequestBypassThrottle</code> has another value, for example 70, it means that 70% of all requests disregard the blacklisting and the requests are sent anyway.</p>



Table 2 Changed Attributes

Attribute Name	Description In vSCSF 1.6.x	Description In vSCSF 1.11.0
cscfBlacklistingSipTransactionTimeoutBy passThrottle	<p>This parameter controls how many initial SIP requests should be sent to destinations that have been blacklisted as unreachable because of a SIP Transaction time-out. It is possible to define the percentage of requests that should be sent in this case.</p> <p>If CscfBlacklistingSipTransactionTimeoutBypassThrottle has the value 0, it means that CSCF behaves as recommended in standards, that is, send a 500 error if all destinations are blacklisted. The unreachable destination transport address is blacklisted for a configurable period of time (CscfDestinationUnavailabilityTimer).</p> <p>If blacklisting reason is SIP Transaction time-out and CscfBlacklistingSipTransactionTimeoutBypassThrottle has the value 100, it means that no matter for how long the node is blacklisted, the CSCF tries to send requests towards it in 100% of the cases (that is, ignore the blacklisting completely).</p> <p>If CscfBlacklistingSipTransactionTimeoutBypassThrottle has another value, for example 70, it means that 70% of all requests disregards the blacklisting and the requests are sent anyway. This parameter takes precedence over CscfBlacklistingBypassThrottle in case blacklisting reason is SIP Transaction time-out.</p> <p>This parameter is a sequence with only one element. To change its value with the ECLI, use one of these syntaxes:</p> <pre>cscfBlacklistingSipTransactionTimeoutBypassThrottle[@1]=<new_value></pre> <pre>cscfBlacklistingSipTransactionTimeoutBypassThrottle[<old_value>]=<new_value></pre>	<p>This parameter controls how many initial SIP requests should be sent to destinations that have been blacklisted as unreachable because of a SIP Transaction time-out. It is possible to define the percentage of requests that should be sent in this case. As long as at least one destination transport address is not blacklisted, that address is used and this parameter has no effect.</p> <p>If cscfBlacklistingSipTransactionTimeoutBypassThrottle has the value 0, it means that CSCF does not overrule blacklisting for destinations blacklisted because of SIP transaction time-out. The unreachable destination transport address is blacklisted for a configurable period of time (cscfDestinationUnavailabilityTimer).</p> <p>If blacklisting reason is SIP Transaction time-out and cscfBlacklistingSipTransactionTimeoutBypassThrottle has the value 100, it means that no matter for how long the node is blacklisted, the CSCF tries to send requests towards it in 100% of the cases (that is, ignore the blacklisting completely).</p> <p>If cscfBlacklistingSipTransactionTimeoutBypassThrottle has another value, for example 70, it means that 70% of all requests disregards the blacklisting and the requests are sent anyway.</p> <p>This parameter is a sequence with only one element. To change its value with the ECLI, use one of these syntaxes:</p> <pre>cscfBlacklistingSipTransactionTimeoutBypassThrottle[@1]=<new_value></pre> <pre>cscfBlacklistingSipTransactionTimeoutBypassThrottle[<old_value>]=<new_value></pre>
Transit Support		
ExtNetSelCallingPartyHeaderPriorityTableEntryClass	Each table entry specifies a SIP header name and an associated priority.	<p>Each table entry specifies a SIP header name and an associated priority. The lower priority number a header has, the higher priority it gets.</p> <p>At startup, ExtNetSelCallingPartyHeaderPriorityTableEntryClass creates 4 entries:</p> <ul style="list-style-type: none"> • P-Served-User = 100 • History-Info = 200 • P-Asserted-Identity = 300 • From = 400 <p>The operator can modify these values at any time.</p>



Table 2 Changed Attributes

Attribute Name	Description In vCSCF 1.6.x	Description In vCSCF 1.11.0
extNetSelPoolMode	<p>This attribute defines if the pool is considered to be in allocated number mode.</p> <ul style="list-style-type: none">• Prerequisite for changing extNetSelPoolMode to 0 is a configured extNetSelPoolURI.• Prerequisite for changing extNetSelPoolMode to 1 is a configured ExtNetSelUnallocatedNrResponseCode. <p>When changing pool mode, all data in the pool that is not used in the new pool mode is automatically erased.</p> <p>Possible Values and Meanings:</p> <ul style="list-style-type: none">• 0 – allocated number• 1 – unallocated number	<p>This attribute defines the result type of the External Network Selection analysis.</p> <ul style="list-style-type: none">• Prerequisite for setting extNetSelPoolMode to ALLOCATED_NUMBER is a configured ExtNetSelPoolURI.• Prerequisite for setting extNetSelPoolMode to UNALLOCATED_NUMBER is a configured ExtNetSelUnallocatedNrResponseCode.• No prerequisite for setting extNetSelPoolMode to TRANSIT or NON_TRANSIT. <p>When changing pool mode, all data in the pool that is not used in the new pool mode automatically is erased.</p> <p>Possible Values and Meanings:</p> <ul style="list-style-type: none">• 0: ALLOCATED_NUMBER - means that the received SIP request is routed.• 1: UNALLOCATED_NUMBER - means that the received SIP request is rejected.• 2: TRANSIT - means that the received request is identified to be a transit call.• 3: NON_TRANSIT - means that HSS is queried before routing the SIP request.
tcscfBehavior	<p>This attribute controls if HSS (LIR) Lookups are performed or not, on the terminating side of I-CSCF.</p> <p>The attribute cscfISPBehavior must be configured to 1 (standalone I-CSCF) when tcscfBehavior is enabled. This attribute is preparing to introduce a new Transit Function CSCF (also referred to T-CSCF).</p> <p>Possible Values and Meanings:</p> <ul style="list-style-type: none">• 0: DISABLED - HSS (LIR) lookups are performed in the I-CSCF for terminating traffic.• 1: ENABLED - HSS (LIR) lookups are NOT performed in the I-CSCF for terminating traffic.	<p>This attribute controls if HSS (LIR) lookups are performed, not performed, or transit verification is done on the terminating side of the I-CSCF.</p> <p>The attribute cscfISPBehavior must be configured to 1 (standalone I-CSCF) when tcscfBehavior is ENABLED.</p> <p>Possible Values and Meanings:</p> <ul style="list-style-type: none">• 0: DISABLED - HSS (LIR) lookups are performed in the I-CSCF for terminating traffic.• 1: ENABLED - HSS (LIR) lookups are NOT performed in the I-CSCF for terminating traffic.• 2: TRANSIT_VERIFICATION - transit verification is done before HSS (LIR) lookups in the I-CSCF for terminating traffic to avoid HSS lookups.



Table 2 Changed Attributes

Attribute Name	Description In vCSCF 1.6.x	Description In vCSCF 1.11.0
VNF Scaling		
cscfProcessBehaviourAtClusterReconfiguration	<p>This parameter is used to indicate the CSCF process termination behavior during Cluster Reconfiguration.</p> <p>Cluster Reconfiguration occurs during:</p> <ul style="list-style-type: none"> • CSCF software upgrade • CSCF Cluster Instance Lock (Virtual deployment locking of VM instance) • CSCF Scale-In and Scale-Out (Virtual deployment only) <p>Possible Values and Meanings:</p> <ul style="list-style-type: none"> • IMMEDIATE = The CSCF application processes are terminated directly. This behavior is preferable for CSCF software upgrade as it reduces the upgrade time. A SIP session that has not been established when reconfiguration happens, fails since the CSCF loses all SIP state information because of the terminated processes. <p>The default value is IMMEDIATE.</p>	<p>This parameter is used to indicate the CSCF process termination behavior during Cluster Reconfiguration.</p> <p>Cluster Reconfiguration occurs during:</p> <ul style="list-style-type: none"> • CSCF software upgrade • CSCF Cluster Instance Lock (Virtual deployment locking of VM instance) • CSCF Scale-In and Scale-Out (Virtual deployment only) <p>Possible Values and Meanings:</p> <ul style="list-style-type: none"> • DELAYED = The CSCF application processes get some extra time, up to 55 seconds, to be terminated gracefully. • IMMEDIATE = The CSCF application processes are terminated directly. A SIP session that has not been established when reconfiguration occurs, fails since the CSCF loses all SIP state information because of the terminated processes. <p>The default value is DELAYED.</p>

3.2.1.2 Deleted Attributes

There are no deleted attributes.

3.2.1.3 Deprecated Attributes

The deprecated attributes are described in Table 3.

Table 3 Deprecated Attributes

Attribute Name	Description
OAM Management (Virtualized)	
numberNormalisationTableSync	This parameter is replaced by numberNormalisationTableEditAction, numberNormalisationTableSyncState, and numberNormalisationTableCommitAction.

3.2.1.4 Obsolete Attributes

There are no obsolete attributes.

3.2.1.5 New Attributes and Environment Variables

The new attributes are described in Table 4.



The new environment variables are described in Table 5.

Table 4 New Attributes

Attribute Name	Description
3rd Party Registration	
scscfReregAsEntry	<p>Each entry in this multi-value attribute holds an IP address of an AS instance. For these IP addresses, CSCF invokes 3rd party registration for re-registration when a 3rd party registration trigger is configured in the service profile of a user even if the Registration Type is not configured with re-registration. An empty list means that the function is disabled.</p> <p>Default value: <No Value>.</p>
Graceful Shutdown	
scscfShuttingdownBehavior	<p>This attribute configures when the S-CSCF automatically sets <code>cscfAdministrativeState</code> from SHUTTINGDOWN to LOCKED. The configured value takes effect when <code>cscfAdministrativeState</code> is set to SHUTTINGDOWN and is valid for the whole shutting down period. This attribute is not access-aware.</p> <p>Do not configure the attribute <code>scscfShuttingdownBehavior</code> to FORCED_TO_LOCKED when the threshold value for number of registered users <code>scscfRegisteredUsersThreshold</code> is larger than 0 and the other way around.</p> <p>Default value: GRACEFUL.</p>



Table 4 New Attributes

Attribute Name	Description
scscfShuttingdownPhasePeriodTimer	<p>This attribute configures the phase length in minutes during which a percentage of the registered users is redirected when the S-CSCF is in shutting down mode. The configured value takes effect when <code>cscfAdministrativeState</code> is set to SHUTTINGDOWN and is valid for during the whole shutting down period. Changing <code>cscfRegistrationRefreshMax</code> during the shutting down period does not affect the shutting down phase period. This attribute is not access-aware.</p> <p>When the parameter <code>scscfShuttingdownPhasePeriodTimer</code> is set to 0, the phase length is set to the maximum registration period <code>cscfRegistrationRefreshMax</code>.</p> <p>Default value: 0.</p>
scscfShuttingdownPhases	<p>This attribute configures the number of phases that are used to redirect registered users when the S-CSCF is in shutting down mode. The length of one phase is set in <code>scscfShuttingdownPhasePeriodTimer</code> or <code>cscfRegistrationRefreshMax</code>. The configured value takes effect when <code>cscfAdministrativeState</code> is set to SHUTTINGDOWN and is valid for the whole shutting down period. This attribute is not access-aware.</p> <p>Default value: 0.</p>
Implicit Registration	



Table 4 New Attributes

Attribute Name	Description
sccsfPAssociatedUriBehavior	<p>This parameter configures the behavior of the S-CSCF to determine the sorting order of unbarred public identities in the list of P-Associated-URI that is added to the REGISTER response. The sorting order is applied on public identities (IMPUs) in the Service Profile that is associated with the public identity and is presented in the To header in the registration request. In the sorting, the first non-barred SIP URI in the Service Profile is added as the first entry in the list of URIs in the P-Associated-URI header. The first non-barred tel URI in the Service Profile is added as the second entry. Other non-barred public identities in the Service Profile are added to the header in a random way.</p> <p>The following are possible parameter values:</p> <ul style="list-style-type: none">• 0: There is no sorting done based on the Service Profile. The default IMPU is placed first, and all rest of IMPUs in the IRS in a nonspecific order.• 1: There is sorting for emergency registration. The IMPUs from the Service Profile that do not belong to an emergency registration are not included. For normal registrations, the behavior is as described for value 0.• 2: For normal registrations, the IMPUs in the Service Profile are added first. The other IMPUs in the Implicit Registration Set (IRS) are added afterward in a random way. Emergency registrations are sorted as described for value 1. <p>The default value is 0.</p>
Load Regulation	



Table 4 New Attributes

Attribute Name	Description
cscfSipOverloadAbatement	<p>This attribute defines the threshold of the average cluster resource utilization percentage that triggers the decrement of the oc parameter value. The CSCF periodically decreases the reported oc parameter value, while the average cluster resource utilization level value is smaller than this threshold.</p> <p>This attribute is only applicable when <code>cscfSipOverloadControlReportingEnabled</code> is true. This attribute is not access-aware.</p> <p>This attribute is an integer between 0–100. The value must not be larger than the value of <code>cscfSipOverloadOnset</code>.</p> <p>The default value is 75.</p>
cscfSipOverloadDecrementStep	<p>The attribute defines the value of the step with which the oc parameter value is decreased. This attribute is only applicable when <code>cscfSipOverloadControlReportingEnabled</code> is true. This attribute is not access-aware.</p> <p>This attribute is an integer between 0–100.</p> <p>The default value is 1.</p>
cscfSipOverloadIncrementStep	<p>The attribute defines the value of the step with which the oc parameter value is increased. This attribute is only applicable when <code>cscfSipOverloadControlReportingEnabled</code> is true. This attribute is not access-aware.</p> <p>This attribute is an integer between 0–100.</p> <p>The default value is 2.</p>
OAM Management (Virtualized)	
cscfLockedBehavior	<p>This attribute describes the behavior of the CSCF during the Locked state. The configured value takes effect when <code>cscfAdministrativeState</code> is set to 0 (LOCKED). This attribute is not access-aware.</p> <p>Possible values are GRACEFUL, IGNORE_REQUESTS, and FORCED.</p> <p>The default value is GRACEFUL.</p>



Table 4 New Attributes

Attribute Name	Description
numberNormalisationTableSyncState	<p>This attribute is read-only. It indicates the state of Number Normalization table by changing its value among Initial, Editing, Syncing and Active.</p> <p>The default value is Initial.</p>
numberNormalisationTableEditAction	<p>This attribute is run through ECLI for activating editing of Number Normalization table.</p> <p>It does not have a default value.</p>
numberNormalisationTableCommitAction	<p>This attribute is run through ECLI for committing synchronization of Number Normalization table.</p> <p>It does not have a default value.</p>
Offline Charging	
scscfOfflineChargingTriggerAnalysisOnOutgoingRequest	<p>This attribute configures if the offline charging trigger evaluation is based on the outgoing or incoming SIP request.</p> <p>The possible values are:</p> <ul style="list-style-type: none">• Enabled: The content of the outgoing SIP request is used for the offline charging trigger evaluation.• Disabled: The content of the incoming SIP request is used for the offline charging trigger evaluation. <p>The default value is disabled.</p>
SIP Request Handling	



Table 4 New Attributes

Attribute Name	Description
cscfBlacklistingSip503WithoutRetryAfterBypassThrottle	<p>This parameter controls how much of initial SIP requests should be sent to destinations that have been blacklisted as unreachable because of a SIP 503 without Retry-After. It is possible to define the percentage of requests that should be sent in this case.</p> <p>As long as at least one destination transport address is not blacklisted, that address is used and this parameter has no effect.</p> <p>If <code>cscfBlacklistingSip503WithoutRetryAfterBypassThrottle</code> has the value 0, it means that CSCF does not overrule blacklisting for destinations blacklisted because of SIP 503 without Retry-After. The unreachable destination transport address is blacklisted for a configurable period of time (<code>cscfDestinationUnavailabilityTimer</code>).</p> <p>If blacklisting reason is SIP 503 without Retry-After and <code>cscfBlacklistingSip503WithoutRetryAfterBypassThrottle</code> has the value 100, it means that no matter for how long the node is blacklisted, the CSCF tries to send requests towards it in 100% of the cases (that is, ignore the blacklisting completely).</p> <p>If <code>cscfBlacklistingSip503WithoutRetryAfterBypassThrottle</code> has another value, for example 70, it means that 70% of all requests disregards the blacklisting and the requests are sent anyway.</p>



Table 4 New Attributes

Attribute Name	Description
cscfBlacklistingTransportErrorBypassThrottle	<p>This parameter controls how much of initial SIP requests should be sent to destinations that have been blacklisted as unreachable because of a Fatal Transport Error or an ICMP Error. It is possible to define the percentage of requests that should be sent in this case.</p> <p>As long as at least one destination transport address is not blacklisted, that address is used and this parameter has no effect.</p> <p>If <code>cscfBlacklistingTransportErrorBypassThrottle</code> has the value 0, it means that CSCF does not overrule blacklisting to destinations blacklisted because of Fatal Transport Error or ICMP Error. The unreachable destination transport address is blacklisted for a configurable period of time (<code>cscfDestinationUnavailabilityTimer</code>).</p> <p>If blacklisting reason is Fatal Transport Error or ICMP Error and <code>cscfBlacklistingTransportErrorBypassThrottle</code> has the value 100, it means that no matter for how long the node is blacklisted, the CSCF tries to send requests towards it in 100% of the cases (that is, ignore the blacklisting completely).</p> <p>If <code>cscfBlacklistingTransportErrorBypassThrottle</code> has another value, for example 70, it means that 70% of all requests disregards the blacklisting and the requests are sent anyway.</p>



Table 4 New Attributes

Attribute Name	Description
cscfBlacklistingThresholdInterval	<p>This attribute defines the measurement period, in seconds, for blacklisting thresholds.</p> <p>This attribute applies to the following SIP blacklisting reasons:</p> <ul style="list-style-type: none"> • SIP 503 Response with Retry-After • SIP 503 Response without Retry-After • SIP transaction time-out • Fatal transport error (socket error) <p>Accepted range: 0 – 86400</p> <p>When it is set to 0, only CscfDestinationUnavailabilityTimer (or the Retry-After header for SIP 503 responses with Retry-After) is used as measurement period for blacklisting thresholds and blacklisting period.</p>
cscfBlacklistingThresholdIntervalDest	<p>This attribute defines the measurement period, in seconds, for blacklisting thresholds for specific destinations in the network.</p> <p>This attribute applies to the following SIP blacklisting reasons:</p> <ul style="list-style-type: none"> • SIP 503 Response with Retry-After • SIP 503 Response without Retry-After • SIP transaction time-out • Fatal transport error (socket error) <p>Possible values: default or [0–9]{1,10}</p> <p>Accepted length: 1–7</p> <p>When it is set to default, there is no specific configuration for the destination.</p>



Table 4 New Attributes

Attribute Name	Description
cscfPrePagingEnabled	<p>This parameter is used to enable and disable prepaging to reduce Call Setup Time (CST) for terminating calls toward idle mobile UEs.</p> <p>By default, prepaging is disabled with <code>cscfPrePagingEnabled</code> set to false. When prepaging is enabled by setting <code>cscfPrePagingEnabled</code> to true, a SIP OPTIONS is sent when the terminating CSCF is aware of the registered UE.</p>
cscfTcpConfigurationId	<p>This is the key attribute of the <code>cscfTcpConfiguration</code> containing configurable TCP attributes for SIP interfaces. One instance of the <code>cscfTcpConfiguration</code> with the key <code>cscfTcpConfigurationId=0</code> is created at startup. It is impossible to create instances. This instance cannot be deleted.</p>
cscfTcpRetransmissionTimeout	<p>This attribute is used to configure the time in seconds that transmitted data can remain unacknowledged before the TCP forces the corresponding connection to close. A value of 0 means that the TCP uses the system default settings. A change of this attribute can take up to 5 minutes to take effect and only affects new TCP connections.</p> <p>Possible values: 0–1200.</p> <p>The default value is 0.</p>
cscfTcpSessionConnectTimeout	<p>This attribute is used to configure the maximum time in seconds that SYN retransmits are sent before aborting the attempt to establish a connection. A change of this attribute can take up to 5 minutes to take effect and only affects new TCP connections.</p> <p>Possible values: 1, 3, 7, 15, 31, and 63.</p> <p>The default value is 31.</p>



Table 4 New Attributes

Attribute Name	Description
cscfTcpSessionDelayAck	<p>This attribute is used to configure TCP optimization for reducing the number of ACKs required to acknowledge outstanding segments. A change of this attribute can take up to 5 minutes to take effect.</p> <p>Possible values and meaning:</p> <ul style="list-style-type: none"> • default: Leave the decision to enter or leave quick ACK-mode to TCP. • enabled: Turn on TCP optimization for reducing the number of ACKs that is required to acknowledge outstanding segments. • disabled: Turn off TCP optimization for reducing the number of ACKs that is required to acknowledge outstanding segments. <p>The default value is default.</p>
cscfTcpSessionInactiveTimeout	<p>This attribute is used to configure the time in seconds the connection needs to remain idle before closing the connection. It is recommended to set the value of this attribute to a value larger than that of cscfMonitorFallbackCheckTimer. The change of this attribute can take up to 5 minutes to take effect and only affects new TCP connections.</p> <p>Possible values: 1–3600.</p> <p>The default value is 60.</p>
cscfTcpSessionNoDelay	<p>This attribute is used to control the Nagle algorithm in TCP, which means if data is buffered until there is enough to send out or not. The change of this attribute can take up to 5 minutes to take effect and only affects new TCP connections.</p> <p>Possible values and meaning:</p> <ul style="list-style-type: none"> • 0: Enable the Nagle algorithm in TCP. • 1: Disable the Nagle algorithm in TCP. <p>The default value is 1.</p>



Table 4 New Attributes

Attribute Name	Description
cscfTcpSessionQueueSize	<p>This attribute is used to configure the maximum number of SIP messages that can queue in a TCP session when SIP messages are sent. If the queue is full, negative responses are returned with relevant socket error information. The change of this attribute can take up to 5 minutes to take effect and only effects new TCP connections.</p> <p>Possible values: 5–100.</p> <p>The default value is 10.</p>
Transit Support	
extNetSelectionInitialTransitTableName	<p>This parameter must be configured with the name of the ENS table to indicate where to start a navigating table for transit verification. The referenced table must be configured before this parameter can be changed.</p> <p>A defined ENS navigation and matching for transit verification. For example: SipMessage:[tableName], calling:[tableName], P-Asserted-Identity:[tableName], CIC:[tableName], RN:[tableName] or called:[tableName].</p> <p>The default value is None.</p>
VNF Scaling	
cscfScalingId	<p>This is the key attribute of the CscfScalingClass containing all the scaling-related parameters. One instance of the CscfScalingClass with the key cscfScalingId=default is created at startup. This instance cannot be deleted.</p>
cscfScaleIn	<p>This parameter defines the time and targeted cluster size after scale-in (number of PLs).</p> <p>The default value is N/A.</p>
cscfScaleOut	<p>This parameter defines the time and targeted cluster size after scale-out (number of PLs).</p> <p>The default value is N/A.</p>
cscfTimeBasedScalingEnabled	<p>This parameter is used to enable the time-based scaling alert to trigger the scaling workflow.</p> <p>The default value is false.</p>



Table 5 New Environment Variables

New Environment Variable	Description
Offline Charging	
CSCF_CHARGING_BACKUP_RETRY_LIMIT	<p>This parameter defines the maximum number of retries to back up an offline charging request. After all retries fail, the charging information is lost. Together with parameter CSCF_CHARGING_BACKUP_RETRY_TIMER_INTERVAL, this parameter defines how long time the charging information is cached in the memory at most, but not more than 10 minutes. The value 0 disables caching of the charging information at backup failure.</p> <p>Range: 0–5</p> <p>Default value: 3</p>
CSCF_CHARGING_BACKUP_RETRY_TIMER_INTERVAL	<p>This parameter defines the time interval between two retries to back up an offline charging request. Together with parameter CSCF_CHARGING_BACKUP_RETRY_LIMIT, this parameter defines how long time the charging information is cached in the memory at most, but not more than 10 minutes.</p> <p>Unit: s</p> <p>Range: 10–180</p> <p>Default value: 20</p>

3.2.2 Fault Management

This section describes alarms that have been changed, deleted, or added.

3.2.2.1 Changed Alarms

The changed alarms are described in Table 6.

Table 6 Changed Alarms

Alarm Name	Description of Change
Offline Charging	
CSCF Charging Backup File System Unavailable	The value of Additional Text is changed to Backup Write Failure or Backup Disk Full.
Transit Support	



Table 6 Changed Alarms

Alarm Name	Description of Change
CSCF External Network Selection Initial Table Incorrectly Configured	<p>The alarm also is raised when the <code>extNetSelectionInitialTransitTableName</code> parameter is set to an empty table that does not contain any entries, or when some other configuration error is discovered in the ENS tables.</p> <p>For the initial table <code>extNetSelectionInitialTableName</code>, the Additional Text field states Configured Initial Table <table type>:<tablename> is empty.</p> <p>For the initial transit table <code>extNetSelectionInitialTransitTableName</code>, the Additional Text field states Configured Initial Transit Table <table type>:<tablename> is empty.</p>
CSCF External Network Selection Memory Limit Reached	When this alarm is raised, any transit verification causes all SIP messages to be handled as non-transit.
CSCF External Network Selection Table Loop Detected	<p>This alarm indicates if a loop was detected in the transit verification analysis or in the External Network Selection analysis.</p> <p>The Additional Info field is extended as <code>R:SipMessage=[INVITE tel:+468000000000 SIP/2], SdpMediaType=[]</code> or <code>T:SipMessage=[INVITE tel:+468000000000 SIP/2], SdpMediaType=[]</code>, where R stands for External Network Selection and T stands for transit verification.</p>

3.2.2.2 Deleted Alarms

There are no deleted alarms.

3.2.2.3 Deprecated Alarms

There are no deprecated alarms.

3.2.2.4 Obsolete Alarms

There are no obsolete alarms.



3.2.2.5 New Alarms

The new alarms are described in Table 7.

Table 7 New Alarms

Alarm Name	Description
OAM Management (Virtualized)	
C-Diameter, Diameter Measurement Threshold Crossed	This generic C-Diameter threshold-based alarm was raised because at the end of the Granularity Period the measured value for one of the DiameterCC measurement types was higher than the configured threshold.
C-Diameter, Peer Connection Congestion	This generic C-Diameter threshold-based alarm indicates congestion in the Own or in the Peer Diameter Node. The congestion was measured on one of the peer connections, that is, the message amount dropped because the diameter link congestion crossed the threshold defined by the related threshold job level.
C-Diameter, RTT to Remote Node Exceed Limits	This generic C-Diameter threshold-based alarm indicates disturbances in egress request message delivery. That is, the message amount dropped because the time-out crossed the threshold defined by the related threshold job.

3.2.3 SNMP Alerts

This section describes SNMP Alerts that have been changed, deleted, or added.

3.2.3.1 Changed SNMP Alerts

There are no changed events and notifications.

3.2.3.2 Deleted SNMP Alerts

There are no deleted events and notifications.

3.2.3.3 Deprecated SNMP Alerts

There are no deprecated events and notifications.

3.2.3.4 Obsolete SNMP Alerts

There are no obsolete events and notifications.



3.2.3.5 New SNMP Alerts

The new SNMP alerts are described in Table 8.

Table 8 New SNMP Alerts

SNMP Alert Name	Description
VNF Scaling	
CSCF Time-Based Scaling	<p>When <code>cscfScaleIn</code> is expired, the following SNMP alert that includes alert name and the additional text is raised: CSCF Time Based Scaling, CSCF Time Based Scale In: <code><numberOfPayload></code></p> <p>When <code>cscfScaleOut</code> is expired, the following SNMP alert that includes alert name and the additional text is raised: CSCF Time Based Scaling, CSCF Time Based Scale Out: <code><numberOfPayload></code>.</p>

3.2.4 Events and Notifications

This section describes events and notifications that have been changed, deleted, or added.

3.2.4.1 Changed Events and Notifications

There are no changed events and notifications.

3.2.4.2 Deleted Events and Notifications

There are no deleted events and notifications.

3.2.4.3 Deprecated Events and Notifications

There are no deprecated events and notifications.

3.2.4.4 Obsolete Events and Notifications

There are no obsolete events and notifications.

3.2.4.5 New Events and Notifications

There are no new events and notifications.



3.2.5 Counters

This section describes counters that have been changed, deleted, or added.

3.2.5.1 Changed Counters

The changed counters are described in Table 9.

Table 9 Changed Counters

Counter Name	Description of Change
Graceful Shutdown	
cscfConcurrentRegistrations	<p>The description and condition of counter <code>cscfConcurrentRegistrations</code> are changed to reflect the use of this counter in a better way.</p> <p>There is no functional change of this counter.</p>
cscfConcurrentRegisteredUserProfiles	<p>The condition of counter <code>cscfConcurrentRegisteredUserProfiles</code> is changed to reflect the use of this counter in a better way.</p> <p>There is no functional change of this counter.</p>
cscfPeakConcurrentRegistrations	<p>The description and condition of counter <code>cscfPeakConcurrentRegistrations</code> are changed to reflect the use of this counter in a better way.</p> <p>There is no functional change of this counter.</p>
cscfPeakConcurrentRegisteredUserProfiles	<p>The condition of counter <code>cscfPeakConcurrentRegisteredUserProfiles</code> is changed to reflect the use of this counter in a better way.</p> <p>There is no functional change of this counter.</p>
scscfConcurrentUnregisteredUserProfiles	<p>The condition of counter <code>scscfConcurrentUnregisteredUserProfiles</code> is changed to reflect the use of this counter in a better way.</p> <p>There is no functional change of this counter.</p>
scscfPeakConcurrentUnregisteredUserProfiles	<p>The condition of counter <code>scscfPeakConcurrentUnregisteredUserProfiles</code> is changed to reflect the use of this counter in a better way.</p> <p>There is no functional change of this counter.</p>

3.2.5.2 Deleted Counters

There are no deleted counters.



3.2.5.3 Deprecated Counters

The deprecated counters are described in Table 10.

Table 10 Deprecated Counters

Counter Name	Description
OAM Management (Virtualized)	
cscfActiveUsers	The measurement status of the PM counter <code>cscfActiveUsers</code> is set to DEPRECATED.
cscfActiveUsersPerProfile	The measurement status of the PM counter <code>cscfActiveUsersPerProfile</code> is set to DEPRECATED.

3.2.5.4 Obsolete Counters

There are no obsolete counters.

3.2.5.5 New Counters

The new counters are described in Table 11.

Table 11 New Counters

Counter Name	Description
Load Regulation	
cscfSipReportingOverloadControlDuration	This counter shows the number of seconds that the node spent in the overload condition during a Granularity Period.
cscfSipReportingOverloadControlPeriods	This counter shows the number of times when the node entered the overload operation mode during a Granularity Period.
OAM Management (Virtualized)	
DiaNode	This C-Diameter Performance Management group consists of 49 new counters. For more information, see Managed Object Model (MOM) .
DiaPeer	This C-Diameter Performance Management group consists of 49 new counters. For more information, see Managed Object Model (MOM) .
DiaPeerConn	This C-Diameter Performance Management group consists of 49 new counters. For more information, see Managed Object Model (MOM) .



4 Summary of Impacts per Feature

This section summarizes the impact per feature when the feature is turned off, as listed in Table 12.

The description of impact is as follows:

- **Major Impact** means that the feature has done an incompatible change so that another node requires an update.
- **Minor Impact** means that the feature has caused changes that affect other nodes, but with extra configuration, the previous behavior can be kept.
- **No Impact** means that the feature has no impact on the system.

Table 12 Impacts per Feature

Feature	Impact			Basic or Optional New or Enhanced	Included in Value Packs and Basic Packs	Relation to Other Features or Nodes
	Major	Minor	No			
3rd Party Registration			X	Basic Enhanced	Voice Messaging Service Identity SIP Trunking Dynamic User	AS
Authentication			X	Optional Enhanced	Voice Messaging Service Identity SIP Trunking Dynamic User	
Emergency Call Handling			X	Optional Enhanced	Voice. Service Identity SIP Trunking Dynamic User	
Graceful Shutdown			X	Basic Enhanced	Voice Messaging Service Identity SIP Trunking Transit Dynamic User	S-CSCF AS HSS



Table 12 Impacts per Feature

Implicit Registration			X	Basic Enhanced	Voice Messaging Service Identity SIP Trunking Dynamic User	P-CSCF UE
Load Regulation			X	Basic Enhanced	Voice Messaging Service Identity SIP Trunking Transit Dynamic User	SIP nodes supporting the Reporting Role for SIP Overload Control (RFC 7339) HSS
OAM Management (Virtualized)			X	Basic Enhanced	Voice Messaging Service Identity SIP Trunking Transit Dynamic User	NeLS Cloud Infrastructu re
Offline Charging			X	Basic Enhanced	Voice Messaging Dynamic User SIP Trunking Service Identity	Charging Control Function
P-CSCF Restoration			X	Optional Enhanced	Voice Messaging Service Identity SIP Trunking Dynamic User	
SIP Request Handling		X		Basic Enhanced	Voice Messaging Service Identity SIP Trunking Transit Dynamic User	SIP Nodes
Traceability and Troubleshooting			X	Basic Enhanced	Voice Messaging Service Identity SIP Trunking Transit Dynamic User	Core Networks Operations Manager



Table 12 Impacts per Feature

Transit Support		X		Optional Enhanced	Transit	
User Initiated Registration/Deregistration			X	Optional Enhanced	Voice Messaging Service Identity SIP Trunking Dynamic User	
VNF-LCM Workflows			X	Optional Enhanced	Voice Messaging Service Identity SIP Trunking Transit Dynamic User	ENM
VNF Robustness			X	Basic Enhanced	Voice Messaging Service Identity SIP Trunking Transit Dynamic User	
VNF Scaling		X		Basic Enhanced	Voice Messaging Service Identity SIP Trunking Transit Dynamic User	





5 Impact on CSCF Features

This section shows the impact on the CSCF features when the feature is turned on.

5.1 3rd Party Registration

This section describes the enhanced feature 3rd Party Registration.

5.1.1 Description

This enhancement enables 3rd party registration when an AS needs to redistribute users to another AS instance because of different reasons. In most cases, the 3rd party registration trigger is not configured for re-registration, which prevents traffic from being redistributed in time. This problem is solved by enabling the CM parameter `scscfReregAsEntry`.

Redistribution of AS traffic is only needed when AS caching is used, meaning when the parameter `as-profile` is set to 1 in the service profile of a user.

Each entry in the multi-value attribute `scscfReregAsEntry` holds an IP address of an AS instance. For these IP addresses, CSCF invokes 3rd party registration for re-registration requests when a 3rd party registration trigger is configured in the service profile of a user even if the Registration Type is not configured with re-registration.

An empty `scscfReregAsEntry` list means that this function is disabled.

When the traffic handover to the target AS node reaches the desired level, the `scscfReregAsEntry` for the specific AS is disabled.

5.2 Authentication

This section describes the enhanced feature Authentication. The enhancements in this feature are valid for all authentication features in the CSCF.

5.2.1 Description

The CSCF authentication is updated to follow 3GPP standards.

The S-CSCF does not authenticate REGISTER requests when the integrity-protected parameter in the Authorization header of the REGISTER request is set to **auth-done**. This behavior is valid for initial registration, re-registration, de-registration, and querying registration.

5.3 Emergency Call Handling

This section describes the enhanced feature Emergency Call Handling.

5.3.1 Description

If an emergency call is rejected by the last Public Safety Answering Point (PSAP) assigned by the Location Repository Function (LRF), and the default PSAP is not configured or the call is a service test call, the Emergency Call Session Control Function (E-CSCF) forwards the SIP error response that it received from the last failed PSAP to the caller. This behavior applies to an E-CSCF with a SIP-based MI interface.

5.4 Graceful Shutdown

This section describes the enhanced feature Graceful Shutdown.

5.4.1 Description

Redirection Distribution of re-REGISTER Requests

When a standalone S-CSCF or a collocated S-CSCF enters in shutting down state, the S-CSCF distributes the redirection of re-REGISTER requests registered users over the number of phases as configured in `scscfShuttingdownPhases`. The phase length is set to the maximum registration refresh time as configured in `cscfRegistrationRefreshMax` or `scscfShuttingdownPhasePeriodTimer`.

When `scscfShuttingdownPhases` is 0, the user redistribution function is triggered without considering the value of `scscfShuttingdownPhasePeriodTimer` and `scscfShuttingdownBehavior`.

When the limit intensity of redirected register requests is triggered, the behavior of the S-CSCF can be configured by setting `scscfShuttingdownBehavior` to one its two options, see [CSCF Configuration Management](#)

Unregistered Users in Shutting down State

To get a faster graceful shutdown behavior and not prevent the Serving Call Session Control Function (S-CSCF) to automatically transit from Shutting Down to Locked state, a new behavior for the unregistered users is introduced.

When `cscfAdministrativeState` is set to **SHUTTINGDOWN**, unregistered users are started to be deregistered by the S-CSCF. Any new session establishment attempt related to services for unregistered or not-registered users are rejected through a SIP 480 response when `scscfRedundantScscfEntry` is empty. When `scscfRedundantScscfEntry` is configured, they are rejected through a SIP 305 response.



When all registered users are deregistered, the S-CSCF automatically sets `cscfAdministrativeState` to **LOCKED**, even when any unregistered users remain in the S-CSCF.

5.5 Implicit Registration

This section describes the enhanced feature Implicit Registration.

5.5.1 Description

Through Implicit Registration, the S-CSCF is able to sort the IP Multimedia Public Identities (IMPUs) in the list of the P-Associated-URI that is added to the REGISTER response. The sorting is done based on the Home Subscriber Server (HSS) Service Profile that the IMPU belongs to at registration: the registration Service Profile.

To support multi-SIM service for emergency calls, a secondary device must not get the IMPU of the primary device as its top IMPU. Therefore, the S-CSCF allows the IMPUs that are found in the Service Profile of the registering IMPU to return in the top of the P-Associated-URI list.

In the sorting, the first non-barred SIP URI in the Service Profile is added as the first entry in the list of URIs in the P-Associated-URI header. The first non-barred tel URI in the Service Profile is added as the second entry. Other non-barred public identities in the Service Profile are added to the header in a random way. The value of `scscfPAssociatedUriBehavior` determines if the S-CSCF sorts only the IMPUs from emergency registrations or the IMPUs from all registrations.

5.6 Load Regulation

This section describes the enhanced feature Load Regulation.

5.6.1 Description

Reporting Role for SIP Overload Control

The calculation of the percentage level of the value of the `oc` parameter is based on the average cluster Resource Utilization Information (RUI) and the previous `oc` value.

The `oc` value is adjusted according to the following rules:

- At the initial phase, the `oc` value is set to 0. This indicates no SIP server overload.
- The `oc` value is increased and decreased as follows (see also Figure 1):

- The oc value increases when the resource utilization level is larger than the Overload Onset (OO) threshold.
- The oc value remains unchanged when the resource utilization level is between the Overload Onset (OO) threshold and Overload Abatement (OA) threshold.
- The oc value decreases when the resource utilization level is lower than the Overload Abatement (OA) threshold.

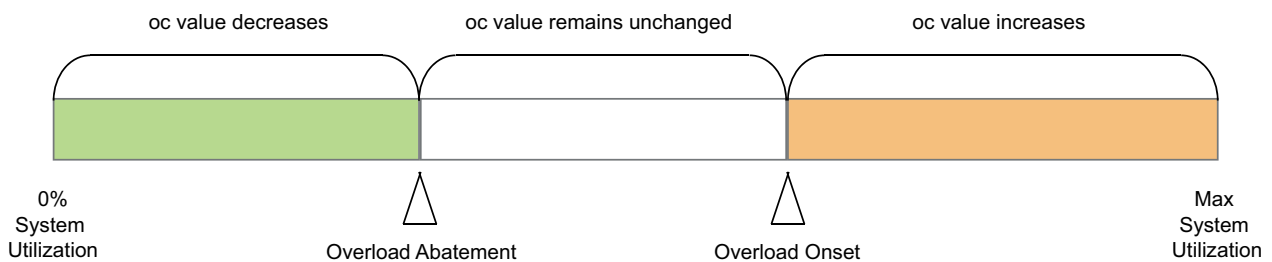


Figure 1 Scenario of the Increase and Decrease of the oc Parameter Value

The following Configuration Management parameters can be used to adjust the oc value:

— `cscfSipOverloadOnset`

When the RUI reaches the Overload Onset threshold, the CSCF increases oc value.

— `cscfSipOverloadAbatement`

When the RUI falls below the Overload Abatement (OA) threshold, the CSCF decreases oc value.

— `cscfSipOverloadIncrementStep`

The step value with which the CSCF increases the value of oc.

— `cscfSipOverloadDecrementStep`

The step value with which the CSCF decreases the value of oc with.

When upgrading from an older CSCF version that supports SIP Overload Control, some existing CM parameter values are overwritten with new default values.

If the parameter `cscfSipOverloadOnset` is already configured in the system, evaluate its value considering the modified calculation of the oc value. The new default value provides a better behavior in general.

The propagation delay of reporting the cluster average Resource Utilization Information (RUI) is reduced. The algorithm to calculate the sent oc-value from the RUI according to [RFC 7339](#) has changed slightly. There is no longer a need to set `PM_COLLECTOR_FLUSH_PERIOD` to 1, but the default value of 5 is used. These



changes improve the performance and stability of the SIP Overload Control Reporting Role of the CSCF.

Reacting Role for SIP Overload Control

All SIP requests with priority level 0 in the Configuration Management parameter `cscfSipOverloadControlReactingTrafficPriorities` are never redirected or rejected.

5.7 OAM Management (Virtualized)

This section describes the enhanced feature OAM Management (Virtualized).

5.7.1 Description

CSCF Locked Behavior

When the CSCF is in the Administrative State Locked, the new parameter `cscfLockedBehavior` defines the behavior of the CSCF.

The parameter `cscfLockedBehavior` has the following settings:

— GRACEFUL

When `cscfAdministrativeState` is set to 0 (LOCKED), the Serving Call Session Control Function (S-CSCF) responds with a 480 (Temporarily Unavailable) response for initial registration, re-registration, and registration of a new contact. All other SIP requests are rejected by 503 (Service Unavailable) responses that are enhanced with the value 5 mins (300 sec) in the Retry-After header. This triggers the client nodes to redirect or blacklist the CSCF in the state LOCKED, so it disconnects all sessions and deregisters all users. The updated 503 (Service Unavailable) response message is applicable for all other CSCF node types.

— IGNORE_REQUESTS

When `cscfAdministrativeState` is set to 0 (LOCKED), the S-CSCF does not respond to any incoming initial SIP requests; it does not send 480 (Temporarily Unavailable) to REGISTER requests or 503 (Service Unavailable) to other requests. The S-CSCF still sends BYE messages to terminate all sessions, SAR, third-party REGISTER, and NOTIFY requests to de-REGISTER all users.

All other CSCF node types ignore the incoming initial SIP requests when `cscfAdministrativeState` is set to 0 (LOCKED).

— FORCED

When `cscfAdministrativeState` is set to 0 (LOCKED), all CSCF nodes immediately close the SIP ports. This means that all external signalling stops. The S-CSCF silently terminates all sessions and removes all registered and unregistered users.

License Management Autonomous Mode

For the License Management, the allowed period in Autonomous Mode is increased from 7 to 90 days.

ECIM for eVIP

eVIP is configured by pushing predefined eVIP configurations to the CSCF with the Parameter Database (PDB) tool.

ECIM for SCTP

ECIM for SCTP is integrated in CSCF for SS7-layer configurations through NBI instead of Signaling Manager GUI and CLI.

Cinder Support

Dependencies to Cinder volumes are added to the System Controller (SC) Virtual Machines (VMs) for Cinder-based setups.

With Cinder support, it is possible to use the Block Storage that is provided in the cloud infrastructure, instead of using Ephemeral Storage on the SC VMs.

Number Normalization Configuration Synchronization

Number Normalization configuration is no longer synchronized by setting `numberNormalisationTableSync`. The configuration modification is initiated by running `numberNormalisationTableEditAction` for active editing and concluded by running `numberNormalisationTableCommitAction` for committing the synchronization.

New Diameter Stack

The C-Diameter stack is integrated with the vCSCF and removed from vDicos. It is backward compatible, but there are some additional O&M-related enhancements.

Three new alarms, C-Diameter, Diameter Measurement Threshold Crossed, C-Diameter, Peer Connection Congestion, and C-Diameter, RTT to Remote Node Exceed Limits are added. For more information, see Section 3.2.2.5 New Alarms on page 25.

New Diameter throughput/latency Performance Management counters are introduced, see Section 3.2.5.5 New Counters on page 28.



Log Management Framework

With the introduction of the Log Management (LogM) framework, centralized registered log stream management through the Northbound Interface (NBI) is possible. This includes setting the severity filter, performing a manual export of logs, and configuring automatic streaming of log entries towards a log server.

5.8 Offline Charging

This section describes the enhanced feature Offline Charging.

5.8.1 Description

Offline Charging Trigger Analysis on Outgoing SIP Request

When the new parameter `scscf0fflineChargingTriggerAnalysis0nOutgoingRequest` is set to **enabled**, the content of the outgoing SIP request is used for the offline charging trigger evaluation. When it is set to **disabled**, the incoming SIP request is used.

Backup Handling

The Additional Text of alarm CSCF Charging Backup File System Unavailable is updated to indicate that the alarm occurs when backing up charging requests fail because of disk full or disk writing failure.

When the charging backup file system fails to back up charging requests because of disk full or disk writing failure, the charging requests are cached in the memory for a predefined time. During the predefined time, the system retries to back up charging requests for predefined times. After all retries fail, the charging requests are lost.

5.9 P-CSCF Restoration

This section describes the enhanced feature P-CSCF restoration.

5.9.1 Description

The condition to trigger the P-CSCF restoration procedure in S-CSCF is expanded from only triggering when access types contain the strings 3GPP-GERAN, 3GPP-UTRAN, or 3GPP-E-UTRAN, to also trigger when they contain 3GPP-NR.

5.10 SIP Request Handling

This section describes the enhanced feature SIP Request Handling.

5.10.1 Description

Prepaging

To reduce Call Setup Time (CST) for terminating calls toward idle mobile UEs, prepaging is enabled to send a SIP OPTIONS in the following scenarios:

- When the terminating I-CSCF is collocated with the S-CSCF where the UE is registered, OPTIONS is sent before the LIR/LIA transaction toward HSS is done.
- When the terminating I-CSCF is not collocated with the S-CSCF where the UE is registered, OPTIONS is sent before the S-CSCF checks whether any IFC is configured to invoke any AS.

Prepaging applies to all UEs that are registered with a P-Access-Network-Info header including the access-type 3GPP-E-UTRAN-FDD, 3GPP-E-UTRAN-TDD, 3GPP-NR-FDD, or 3GPP-NR-TDD.

Network-Initiated De-Registration

At network-initiated de-registration, the S-CSCF releases early dialogues that are associated to the de-registered contact by sending CANCEL in the downstream direction. The CANCEL procedure is managed through the non-INVITE transaction failover timer and can generate a SIP 408 (Timeout) response for the INVITE dialog if there is a transaction time-out of the CANCEL transaction.

Time Period for Accumulating the Blacklisting Thresholds

It is possible to configure the time period for accumulating the blacklisting thresholds interval separately from the blacklisting duration period. The threshold interval can be configured per Fully Qualified Domain Name (FQDN), next to the global configuration.

It applies to the following SIP blacklisting reasons:

- SIP 503 with Retry-After header
- SIP 503 without Retry-After header
- Transaction time-out
- Fatal transport error

If the threshold for one of these reasons is exceeded during the measurement period, the blacklisting period starts. During the blacklisting period, received requests are not forwarded to the blacklisted destination.



Support for Invalid tel URI Format Headers

The P-Asserted-Identity can be used to determine the identity of the served user in the originating S-CSCF or I-CSCF. When there is no valid tel URI available in the P-Asserted-Identity header, but a valid international telephone number is present as the canonical SIP URI in a P-Asserted-Identity header, the CSCF creates a tel URI from the SIP URI and uses it to identify the served user.

Configurable TCP Parameters for SIP Interfaces

TCP parameters for the SIP interfaces in CSCF are configurable on a node level through ECLI and NETCONF. The following TCP parameters are configurable:

- The maximum time in seconds that SYN retransmits are sent before aborting an attempt to establish a connection.
- The amount of time in seconds a connection needs to remain idle before it is closed.
- TCP optimization for reducing the number of ACKs required to acknowledge outstanding segments.
- Control of the Nagle algorithm in TCP, which means if data is buffered until there is enough to send out or not.
- The amount of time in seconds that transmitted data can remain unacknowledged before the TCP forces the corresponding connection to close.
- Maximum number of SIP messages to queue in a TCP session when SIP messages are sent.

CSCF Blacklisting Bypass Configuration for Transport Errors and 503 without Retry-After Header

This enhancement improves the configuration for blacklisting bypass throttle by adding two parameters: `cscfBlacklistingSip503WithoutRetryAfterBypassThrottle` and `cscfBlacklistingTransportErrorBypassThrottle`. This gives more flexibility and control on the traffic that conditionally bypasses the blacklisting.

The overrule behavior of `cscfBlacklistingBypassThrottle` has changed. This parameter still controls the blacklisting overrule behavior for SIP 503 with Retry-After header, but the new parameters control now the overrule behavior for SIP 503 without Retry-After header, Fatal Transport Error, and ICMP Error.

5.11 Traceability and Troubleshooting

This section describes the enhanced feature Traceability and Troubleshooting.



5.11.1 Description

CSCF Health Check Output Format Structure

The CSCF is enhanced to align the CSCF Health Check output format structure and use with other IP Multimedia Subsystem (IMS) Virtual Network Functions (VNFs). The new XML[®] output format enables using the results in a networking monitoring tool. The CSCF also supports new command line options for the Health Check script.

CSCF Health Check Scheduling

Health check can be scheduled to run at a specific time or periodically at fixed times of day using `cron` jobs. The `cron` jobs of scheduled health checks have identities that can be listed. Unused scheduled health check can be deleted by the identities.

CSCF Health Check Single Sign-On Support

The vCSCF supports Single Sign-On for the CSCF health check to align with the health check functions of the other IMS nodes to simplify the use of the Core Network Operations Manager (CNOM).

Logging of Trace Activity

Every time a user starts a NetTrace session or executes UserTrace with the `CscfTrace` script, the identity of the user and the executed command are logged in the Linux[®] Syslog.

System Troubleshooter Role

A new security role, System Troubleshooter, is introduced. For more information, see [User Management](#).

5.12 Transit Support

This section describes the enhanced feature Transit Support.

5.12.1 Description

Transit Verification Function

The transit function in a terminating Interrogating Call Session Control Function (I-CSCF) is enhanced with a transit verification function that enables determination if SIP requests must be transited based on configurable criteria. All SIP requests that fulfill the configured criteria are handled as transit requests for



which Home Subscriber Server (HSS) queries are suppressed. All SIP requests that do not fulfill the configured criteria are handled as non-transit requests.

For example, when a terminating I-CSCF receives a SIP request with a telephone number in its Request-URI, the transit verification function compares the originating network information in the received *Via* header and the called number in the received Request-URI with the configured criteria. If `extNetSelectionInitialTransitTableName` is not configured or the referenced table is misconfigured, all SIP requests are handled as non-transited requests.

The transit verification function is configurable for a standalone I-CSCF and a collocated IS-CSCF.

History-Info in External Network Selection

For call forwarding, the P-Served-User header is always used for External Network Selection (ENS) routing analysis to next hop. In the S-CSCF, when the forwarded call is routed to the I-CSCF, the P-Served-User header is deleted from the SIP request. As shown in Figure 2, there is no P-Served-User header present in the transit I-CSCF. To use the last forwarding user as calling party information for routing in ENS, the History-Info header values have to be used in this case.

The Calling Party Header Priority table is enhanced with the History-Info header, so that the SIP header History-Info is considered when selecting a calling party number in ENS.

The CSCF first checks if the History-Info according to [RFC 7044](#) and then follows [RFC 4458](#) to find the telephone number of the latest forwarding user.

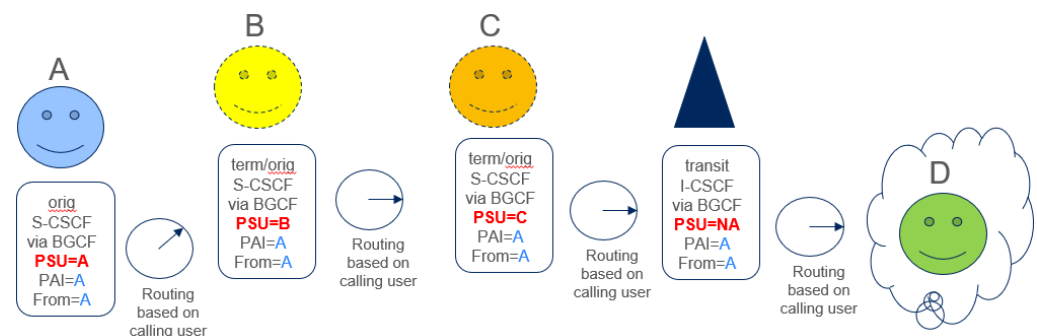


Figure 2 Call Forwarding Scenarios

5.13 User Initiated Registration/Deregistration

This section describes the enhanced feature User Initiated Registration/Deregistration.



5.13.1 Description

The S-CSCF stores the content of the PVNI header of a selected contact in the originating SIP INVITE request. Any PVNI content stored in REGISTER of the same contact is overwritten by the S-CSCF. Stored PVNI content is not removed if there is no PVNI header in the incoming INVITE.

5.14 VNF-LCM Workflows

This section describes the enhanced feature VNF-LCM Workflows.

5.14.1 Description

Supported Workflows

Table 13 All Supported Workflows In vCSCF 1.11.0

	Full Stack OR-VNFM-Triggered	Full Stack VNFM-Triggered	Small Stack	Small Stack
	Openstack	Openstack	Openstack	VMware
Instantiate	Supported	Not supported	Supported	Supported
Terminate	Supported	Supported	Supported	Supported
Heal	Not supported	Not supported	Supported	Not supported
Managed Scaling	Not supported	Not supported	Supported	Supported

The Virtual Network Function Life Cycle Manager (VNF-LCM) Workflows deliver the following operational enhancements:

- Usability improvements in the VDP generator script have changed the parameters and use of the script.
- The scaled out VM names that are visible in VMware NFVI are following an enhanced naming convention.

For vCSCF Workflows, the minimum required version of VNF-LCM is 19.02 (Media version: 4.9.15).

For vCSCF Workflows, the minimum required version of vIMS Common Workflow Bundle is 1.15.2. This is part of the delivered workflow pack.

EM-Driven Instantiation

After a successful instantiation operation from the VNF-LCM finishes successfully, a new Virtual Application belonging to the instantiated VNF is available in the EO too.



Time-Based Scaling

The Managed Scaling workflow can be also triggered for time-based scaling on OpenStack and VMware, see Section 5.16 VNF Scaling on page 45.

5.15 VNF Robustness

This section describes the enhanced feature VNF Robustness.

5.15.1 Description

CSCF-Specific Value of TIPC Timer Attribute

To tolerate temporary disturbances in the underlying cloud network, the value of the LDE TIPC timer attribute `link_tolerance` is increased from 1500ms to 5000ms.

LDE Watchdogd Support

The CSCF now supports the `lde-watchdogd` function that LDE provides as a CBA System Model (CSM) component. The `lde-watchdogd` function provides a configurable watchdog daemon that periodically resets the watchdog timer by writing to `/dev/watchdog`.

The watchdog device can be real hardware, emulated hardware, for example by a Kernel Virtual Machine (KVM) hypervisor, or fully implemented in software as a kernel module.

For a hardware watchdog device, the LDE agent watchdog daemon relies that its driver, the kernel module, is loaded. This is determined by checking for the existence of `/dev/watchdog`. If this file is not there when the LDE agent watchdog service is started, the service attempts to load a software watchdog. This results in `/dev/watchdog` appearing, albeit backed by a software-implemented device.

The watchdog configuration that is used by the LDE `watchdogd` component is set using the parameters provided in the CSM component configuration file `lde-agents-watchdogd.yaml`.

5.16 VNF Scaling

This section describes the enhanced feature VNF Scaling.

5.16.1 Description

The configuration attribute `cscfProcessBehaviourAtClusterReconfiguration` can be set to a new value: **DELAYED**. This new value delays the process termination so the traffic disturbance during Cluster Reconfiguration is reduced.